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PLEISTOCENE SNAILS FROM SAN PATRICIO COUNTY, TEXAS

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Abstract

Pleistocene deposits in the Fordyce Quarry at San Patricio, San Patricio County, Texas are divided into two units: a fossiliferous upper unit consisting of silt with caliche and minor amounts of sand, and a lower unit of gravel and sand, barren of fossils except fragments of reworked extinct Pleistocene vertebrates and reworked Devonian, Cretaceous, and Tertiary fossils.

A snail fauna is identified from the silt and sand of the upper unit consisting of 17 genera including 18 species of land snails and three species of freshwater snails. Sixteen species of land snails and two species of freshwater snails are reported for the first time from the Pleistocene of San Patricio County. *Bulimulus alternatus mariae, Euconulus chersinus trochulus, Helisoma tenue sinuosum,* and *Armigerus obstructus* are reported as fossils for the first time. *Gastrocopta contracta* is reported as a fossil from Texas for the first time. *Gastrocopta armifera, G. tappaniana,* and *Pupoides albilabris* are reported as fossils from south Texas for the first time.

Some species, such as *Gastrocopta tappaniana* and *Pupilla blandi,* in the Fordyce Quarry fauna are characteristic of cool and humid climates, or certainly of temperate zones to the north. *Pupilla blandi* is not known in the Recent of Texas, while *Gastrocopta armifera* and *G. tappaniana* are not known in the Recent of south Texas. Thus a cool and somewhat more humid climatic regimen is indicated for south Texas during the deposition of the sediments of the upper unit in the Fordyce Quarry. The presence of the sedge genus, *Scleria?*, is an indicator of locally moist environmental conditions, but not of the regional climatic regimen.

Evidence derived from the geographic distribution and ecological requirements of many species, the absence of extinct species of snails and vertebrates, coupled with evidence based on the geologic range of the fossil snails indicate that the sediments of the upper unit of the Fordyce Quarry were deposited during Late Wisconsinan times. Some of the species have long stratigraphic ranges; nevertheless, the overall aspects of the mollusks is Wisconsinan. *Pupilla blandi* is known from the pre-Bradyan (Early Wisconsinan), but *Anguispira alternata* and *Stenotrema leai aliciae* are known from only the Bignell loess of Late Wisconsinan (Mankatoan, post-Bradyan) age in the classic Pleistocene section of Kansas.

The stratigraphic position of the lower gravel and sand unit within the Pleistocene sequence could not be determined.

Introduction

Little work has been done on Pleistocene molluscan faunas in south Texas. Measured sections with stratigraphic placement of faunas have been presented only by Conkin and Conkin (1962). Sellards (1940), in his work on the Pleistocene Berclair terrace, dealt primarily with the vertebrate fauna and artifacts, while the snails reported by him were merely listed and not precisely placed within the Pleistocene sequence.

This paper is a continuation of detailed stratigraphic placement of molluscan faunas within the Pleistocene sequence of Texas. The field work for this study was completed in 1955. Sections were measured by hand level and rod.

Acknowledgements

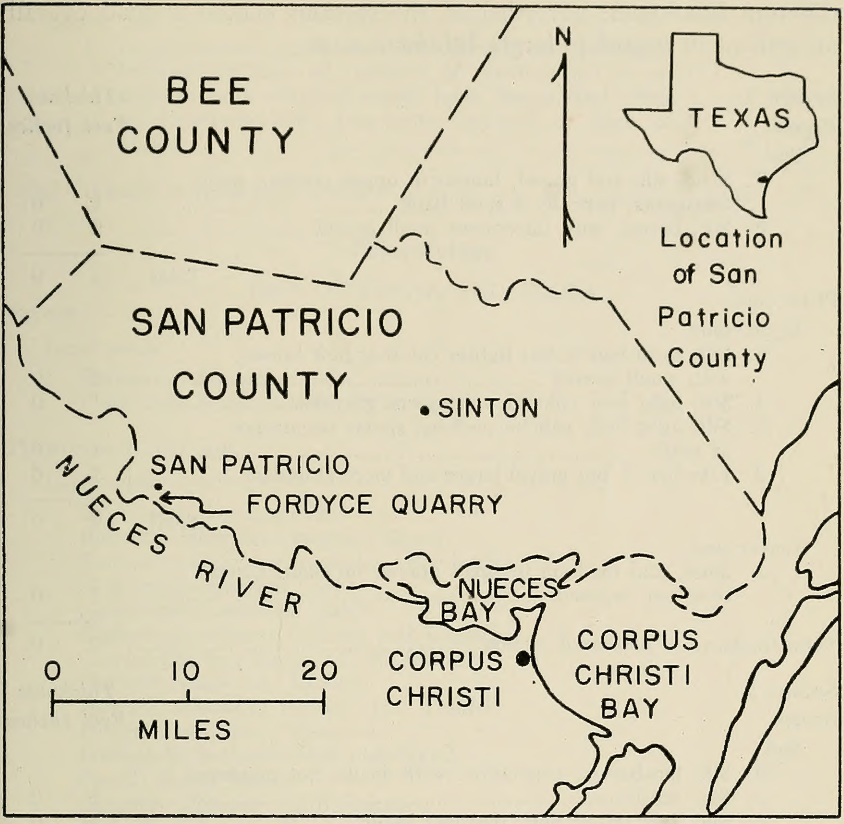
The writers are grateful to the following individuals who were helpful during the completion of this paper: Dr. Joseph P. E. Morrison, Associate Curator, Division of Mollusks of the United States National Museum, for identification of several species and for supplying U. S. National Museum pleisiotype numbers; Mr. Robert Gunn of the Botany Department of Iowa State University at Ames, Iowa for tentative identification of the sedge seed, *Scleria?* sp.

Stratigraphy

The Pleistocene deposits in the Fordyce Quarry at San Patricio, County, Texas (Text-figure 1) are herein divided into two units.

The lower unit, a sand and gravel conglomerate, contains much chalcedony, chert, petrified wood, quartz sand and pebbles, and small vertebrate fragments, including bones and teeth of *Equus* cf. *E. complicatus.* Reworked and silicified specimens of the Devonian tetracoral *Heliophyllum,* and Cretaceous Foraminifera in chert were found in the gravels (Conkin and Conkin, 1962, p. 345); however, most of the sediments were derived from younger beds as evidenced by reworked Tertiary and Quaternary horse teeth and fragments of silicified Miocene palm wood. A portion of the gravel may be derived from erosion of gravels of the Pliocene Goliad formation. No mollusks were found in the lower unit. This lower unit cannot be precisely placed stratigraphically within the Pleistocene sequence.

The lower unit is unconformably overlain by an upper unit consisting of silt and subordinate amounts of coarse to medium-grained sand, with humus in the upper few feet. Caliche is disseminated, or



Text-figure 1.–Location of Fordyce Quarry in San Patricio County, Texas.

concentrated within pockets in this upper unit below the soil horizon. Snails are abundant in the scattered caliche pockets in the silt, and to a lesser degree in the silt itself in the upper unit. Evidence is herein presented for a late Wisconsinan (post-Bradyan) age for the upper unit.

Measured Sections

Two sections were measured and samples taken in the Fordyce Quarry which is located immediately south-southeast of the intersection of farm road 666 and the railroad tracks at San Patricio. The two sections, located only a score of feet apart, were measured near the quarry office. As is usual with Pleistocene terrigenous sediments, the individual beds are rather erratic in their distribution and are discontinuous, with individual layers lensing out and replacing one another laterally so that the two measured sections show somewhat

different lithologies; nevertheless, the sections exhibit a good overall agreement in regard to larger lithologic units.

Section 1	*Thickness*	
Recent	*Feet*	*Inches*
Soil		
7. Sand, silt, and gravel; humus in upper portion; snail fragments; partially a spoil bank	1	0
6. Silt, brown, with infrequent small gravel	2	0
Total	3	0
Pleistocene		
Upper unit		
5. Silt, as in bed 6, but lighter colored, buff brown, with small gravel	2	0
4. Silt, light-buff colored; infrequent gravel	1	0
3. Silt, light buff; caliche pockets; sparse occurrence of snails	1	0
2. Like bed 3, but gravel larger and more abundant	1	0
Total	5	0
Lower unit		
1. Sand, and medium to small gravel; no snails noted; base not exposed	1	0
Total thickness of measured section	9	0

Section 2	*Thickness*	
Recent	*Feet*	*Inches*
Soil		
10. Silt, tan-brown; vegetation; with snails; not measured.		
9. Silt, tan-brown	2	0
8. Silt, light tan to buff; frequent snails	1	0
Total	3	0
Pleistocene		
Upper unit		
7. Silt, light tan to buff; no darkened soil color; small gravel layer in lower 1 to 2 inches; lateral variation, one gully has rare snails in calichified silt, a nearby gully shows frequent snails	2	0
6. Like bed 7, with some gravel; more snails in one gully; caliche beds in nearby gully	2	0
5. Like beds 6 and 7; leached in lower half; silt with infrequent snails, grading into silt with abundant snails	2	0
4. Like bed 5, with caliche nodules and some clayey shale; rare to infrequent snails	2	0
3. Silt, tan-buff, with pockets of fine to medium-grained quartz sand; caliche pockets; no snails noted; clay, ½ to 1 inch thick, at bottom	1	0
2. Sand, quartzose, medium to coarse-grained; no caliche noted; rare pebble-gravel bed immediately overlying an erosional unconformity; no fossils noted	0	9
Total	9	9

Lower unit		
1. Conglomerate, quartz and chert gravel, with pebble to boulder-size material; pockets of medium to coarse-grained sand; petrified wood, horse bones, and other indeterminate bone fragments; covered at base of quarry	3	0
Total thickness of measured section	15	9

Paleontology

LIST OF FAUNA AND FLORA

Recent

Land snails

Bulimulus alternatus mariae (Albers)
Praticolella berlandieriana (Moricand)

Pleistocene Upper unit

Land snails

Anguispira alternata (Say)
Bulimulus alternatus mariae (Albers)
Euconulus chersinus trochulus (Reinhardt)
Gastrocopta armifera (Say)
Gastrocopta contracta (Say)
Gastrocopta cristata (Pilsbry and Vanatta)
Gastrocopta tappaniana (C. B. Adams)
Hawaiia minuscula (Binney)
Helicina orbiculata tropica "Jan" Pfeiffer
Polygyra texasiana (Moricand)
Praticolella berlandieriana (Moricand)
Pupilla blandi Morse
Pupoides albilabris (C. B. Adams)
Retinella indentata (Say)
Retinella indentata paucilirata (Morelet)
Stenotrema leai aliciae (Pilsbry)
Strobilops texasiana (Pilsbry and Ferriss)
Succinea grosvenori Lea
Snail eggs

Freshwater snails

Armigerus obstructus (Morelet)
Helisoma tenue sinuosum (Bonnet)
Physa sp.

Seed

Scleria? sp.

Pleistocene Lower unit

Vertebrates

Reworked Tertiary and early Quaternary forms

Invertebrates

Reworked Devonian *Heliophyllum* sp.

Land Plants

Reworked and silicified Miocene palm wood

Stratigraphic and Geographic Occurrences

Pleistocene mollusks were reported from the undifferentiated Berclair terrace of Blanco Creek, Bee County, Texas and from Pleistocene deposits in San Patricio County, Texas by Sellards (1940); in addition, Conkin and Conkin (1962) reported Pleistocene (Late Wisconsinan) mollusks from the upper unit of the Berclair terrace of Medio Creek in Bee County. A summary of the previously known occurrences of these Pleistocene mollusks in Bee and San Patricio counties is represented in Chart 1. The stratigraphic placement and abundance of the snails in the upper unit of the Fordyce Quarry deposits are shown in Chart 2.

Armigerus obstructus, Bulimulus alternatus mariae, Euconulus chersinus trochulus, and *Helisoma tenue sinuosum* are herein reported

Chart 1. Distribution of Mollusks in the Pleistocene of Bee and San Patricio Counties, Texas

	After Sellards, 1940, p. 1637		Conkin and Conkin, 1962, p. 348, Bee County, Berclair terrace of Medio Creek	
	Bee County, undifferentiated Berclair terrace of Blanco Creek	San Patricio County	Upper Unit (post-Eunice Pleistocene)	Lower Unit (Ingleside correlative)
Bulimulus dealbatus	X		X	X
Helicina orbiculata tropica	X	X	X	
Polygyra texasiana	X	X	X	X
Praticolella berlandieriana			X	X
Retinella indentata			X	
Stenotrema leai aliciae			X	
Stenotrema stenotrema			X	
Succinea avara			X	
Amnicola sp.			X	X
Helisoma antrosa			X	
Helisoma trivolvis	X	X	X	X
Gyraulus parvus		X	X	
Physa sp.				X
Physa conoidea	X			
Physa halei		X		
Physa integra		X		
Amblena perplicata			X	
Lampsilis hydiana			X	
Pisidium sp.			X	
Sphaerium sp.	X			
Uniomeris sp.	X			

Chart 2. Distribution and abundance of snails and the seed *Scleria?* sp. in the upper unit of the Pleistocene deposits of the Fordyce Quarry, San Patricio, Texas. Abundance is indicated by number of specimens; "f" indicates fragmental specimen.

	Section 1		Section 2					
Bed:	5	6	5	6	7	8	9	10
Anguispira alternata	0	0	7	2	1	0	0	0
Bulimulus alternatus mariae	0	f	1f	7	9	3	2	6
Euconulus chersinus trochulus	0	0	5	0	0	0	0	0
Gastrocopta armifera	0	0	66	0	0	0	0	0
Gastrocopta contracta	0	0	121	0	0	0	0	0
Gastrocopta cristata	0	0	488	0	0	0	0	0
Gastrocopta tappaniana	0	0	4	0	0	0	0	0
Hawaiia minuscula	0	0	1	0	0	0	0	0
Helicina orbiculata tropica	0	0	390	1	2	0	0	0
Polygyra texasiana	0	0	136	0	1	0	0	0
Praticolella berlandieriana	1f	f	3	4	6	1	0	5
Pupilla blandi	0	0	25	0	0	0	0	0
Pupoides albilabris	0	0	325	0	0	0	0	0
Retinella indentata	0	0	2	0	0	0	0	0
Retinella indentata paucilirata	0	0	1	0	0	0	0	0
Stenotrema leai aliciae	0	0	29	0	0	0	0	0
Strobilops texasiana	0	0	307	0	0	0	0	0
Succinea grosvenori	0	0	0	2	3	0	0	0
Snail eggs	0	0	3	0	0	0	0	0
Armigerus obstructus	0	0	1	0	0	0	0	0
Helisoma tenue sinuosum	0	0	2	0	0	0	0	0
Physa sp.	0	0	1	0	0	0	0	0
Scleria? sp.	0	0	1	0	0	0	0	0

as fossils for the first time. *Gastrocopta contracta* is reported as a fossil from Texas for the first time. *Pupilla blandi,* herein reported from the Pleistocene, is not known in the Recent of Texas. *Gastrocopta armifera, G. tappaniana* (absent in the Recent of south Texas), and *Pupoides albilabris* are reported as fossils in south Texas for the first time. The following 16 species of land snails and two species of freshwater snails are reported from the Pleistocene of San Patricio County for the first time: *Anguispira alternata, Bulimulus alternatus mariae, Euconulus chersinus trochulus, Gastrocopta armifera, G. contracta, G. cristata, G. tappaniana, Hawaiia minuscula, Praticolella berlandieriana, Pupilla blandi, Pupoides albilabris, Retinella indentata, R. indentata paucilirata, Stenotrema leai aliciae, Strobilops texasiana, Succinea grosvenori, Armigerus obstructus,* and *Helisoma tenue sinuosum.*

Paleoecology

General information concerning climatic and geographic distribution of the snails in the Fordyce deposits has been compiled from

Pilsbry (1940, 1946, and 1948), Baker (1939), Leonard (1950), Franzen and Leonard (1947), Forsyth (1958), and from observations by the senior author in the field.

The snail fauna consists of some species that are cosmopolitan in distribution such as *Anguispira alternata, Gastrocopta armifera, G. contracta, Hawaiia minuscula,* and *Succinea grosvenori.* Other species are characteristic of a southern climate: *Bulimulus alternatus, mariae, Gastrocopta cristata, Helicina orbiculata tropica, Polygyra texasiana, Praticolella berlandieriana, Retinella indentata paucilirata* (although it has been reported from Indiana), and *Strobilops texasiana.* It should be noted that the bulk of the snails as presented in chart 2 are dominantly of a southern climatic regimen. Freshwater snails are cosmopolitan and indicate ponded waters of creeks and rivers.

Many of the species herein reported are characteristically found along watercourses, thus being restricted to humid stations even in semi-arid regions. However, some species recovered from the samples definitely indicate a cool and humid climate; these are: *Gastrocopta tappaniana, Pupilla blandi,* and to a lesser extent, *Retinella indentata* (characteristically a temperate to north-temperate species).

The sedge genus *Scleria?* is indicative of locally, but not regionally, moist environment.

The evidence presented herein, based upon considerations of the geographic distribution and ecological requirements of the species of snails, indicates that climatic conditions were different during the time of deposition of the sediments of the upper unit at the San Patricio site than during the Recent in this area. The subsequent disappearance of *Pupilla blandi* and *Gastrocopta tappaniana* and diminuation of other forms in the Recent is consistent with the change to a warmer and drier climate in south Texas after deposition of the upper unit of the Fordyce deposits.

Age of the Deposits

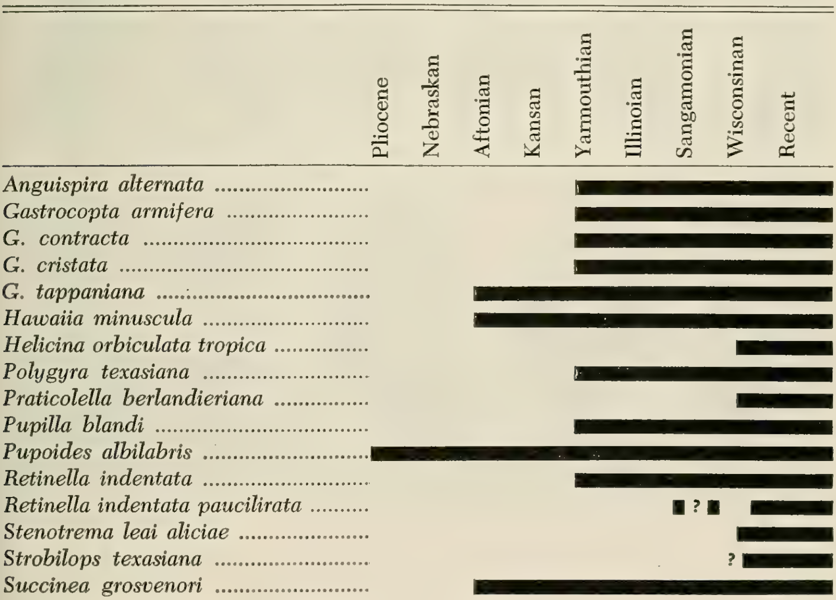
Although some species of snails in the upper unit of the Fordyce deposits are known in the fossil record as far back as the Aftonian, and one species, *Pupoides albilabris,* is recorded from the Pliocene, the bulk of the fauna is not known stratigraphically below the Yarmouthian. Three species, *Helicina orbiculata tropica, Praticolella berlandieriana,* and *Stenotrema leai aliciae,* are not known prior to the Wisconsinan; all three of these species were reported from the post-Eunice Pleistocene by Conkin and Conkin (1962, p. 348). *Pupilla blandi* is known from the pre-Bradyan Wisconsinan. In the well known Pleistocene sequence of Kansas, *Stenotrema leai aliciae* and *Anguispira*

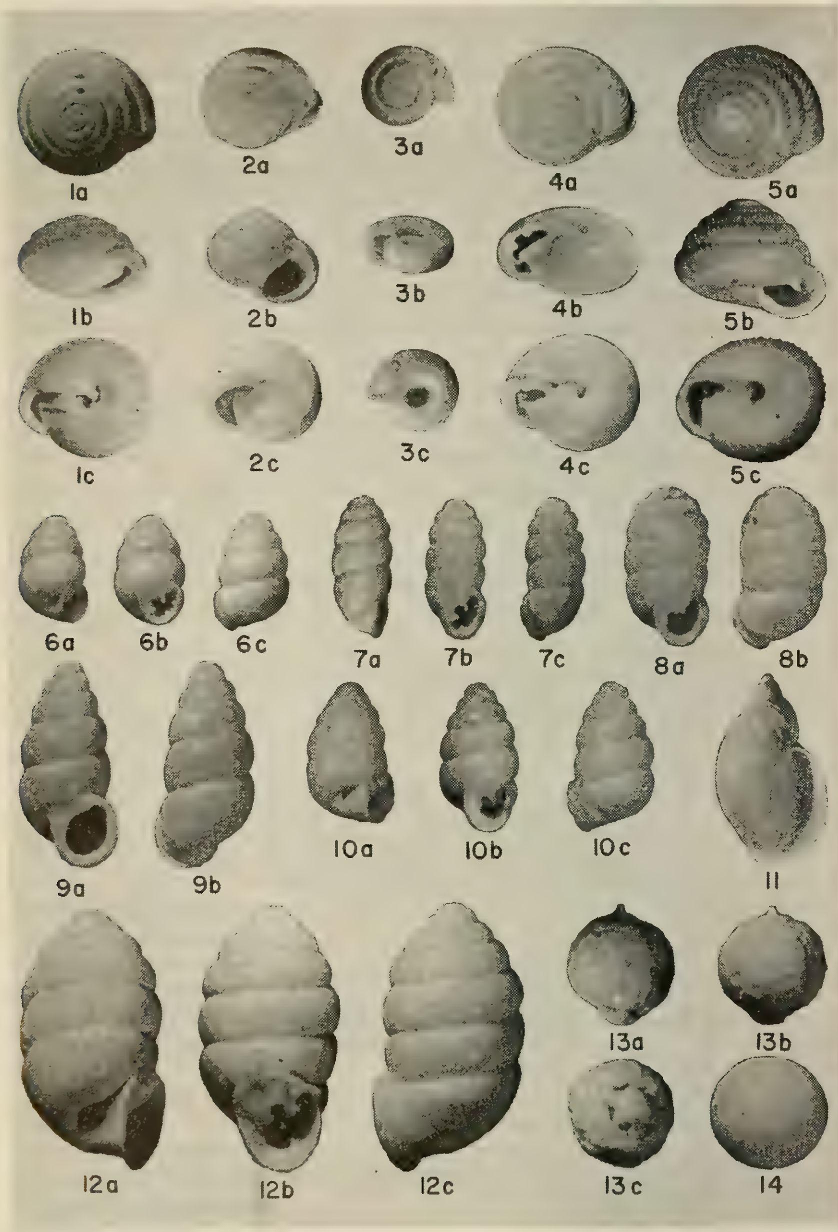
alternata are known from only the post-Bradyan Bignell loess (Leonard, 1952, pp. 176, 182).

Thus, there is definitive evidence for a Wisconsinan age for the upper unit of the Fordyce sediments, in the geologic ranges of the elements of the fauna (Chart 3), in the absence of any extinct species, and in the change in climatic regimen since the deposition of the upper unit sediments. Indeed, the Fordyce deposits probably represent deposition during post-Bradyan (Late Wisconsinan) times.

Although there is a similarity between some elements of the fauna of the upper unit of the Fordyce deposits and the upper unit of the post-Eunice Pleistocene Berclair terrace (Conkin and Conkin, 1962), no correlation is hazzarded inasmuch as there are molluscan elements of a cooler and more humid climatic regimen present in the Fordyce Quarry fauna. The more humid environment represented by the Fordyce fauna might be explained by the undoubtedly more vegetated and broader margins of the greater valley and lower altitude of the Nueces River in contrast with the less vegetated and narrower margins of Medio and Blanco creeks at higher altitudes; but the presence in the Fordyce Quarry deposits of characteristically cooler zone snails indicates a difference in climate during deposition of the two deposits, and thus probably a difference in age.

Chart 3. Previously known range of elements of the Fordyce Quarry fauna (after Pilsbry, 1940; Leonard, 1952; and Conkin and Conkin, 1962).




1a
2a
3a
4a
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1b
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1c
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3c
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6a
6b
6c
7a
7b
7c
8a
8b
9a
9b
10a
10b
10c
11
12a
12b
12c
13a
13b
13c
14

Plate 1

Explanation of Plate 1

Figs. 1a-c.—*Stenotrema leai aliciae;* X 2.1; Fig. 1a, dorsal view; Fig. 1b, apertural view; Fig. 1c, umbilical view; Section 2, bed 5; U. S. N. M. No. 638767.

Figs. 2a-c.—*Helicina orbiculata tropica;* X 2; Fig. 2a, dorsal view; Fig. 2b, apertural view; Fig. 2c, umbilical view; Section 2, bed 5; U. S. N. M. No. 638760.

Figs. 3a-c.—*Hawaiia minuscula;* X 6; Fig. 3a, dorsal view; Fig. 3b, apertural view; Fig. 3c, umbilical view; Section 2, bed 5; N. S. N. M. No. 638759.

Figs. 3a-c.—*Polygyra texasiana;* X 2.1; Fig. 4a, dorsal view; Fig. 4b, apertural view; Fig. 4c, umbilical view; Section 2, bed 5; U. S. N. M. No. 638761.

Figs. 5a-c.—*Strobilops texasiana;* X 7.5; Fig. 5a, dorsal view; Fig. 5b, apertural view; Fig. 5c, umbilical view; Section 2, bed 5; U. S. N. M. No. 638768.

Figs. 6a-c.—*Gastrocopta tappaniana;* X 6; Fig. 6a, oblique apertural view showing umbilicus; Fig. 6b, apertural view; Fig. 6c, side view; Section 2, bed 5; U. S. N. M. No. 638758.

Figs. 7a-c.—*Gastrocopta cristata;* X 7.3; Fig. 7a, oblique apertural view showing umbilicus; Fig. 7b, apertural view; Fig. 7c, side view; Section 2, bed 5; U. S. N. M. No. 638757.

Figs. 8a, 8b.—*Pupilla blandi;* X 7.2; Fig. 8a, apertural view; Fig. 8b, side view; Section 2, bed 5; U. S. N. M. No. 638763.

Figs. 9a, 9b.—*Pupoides albilabris;* X 7; Fig. 9a, apertural view; Fig. 9b, side view; Section 2, bed 5; U. S. N. M. No. 638764.

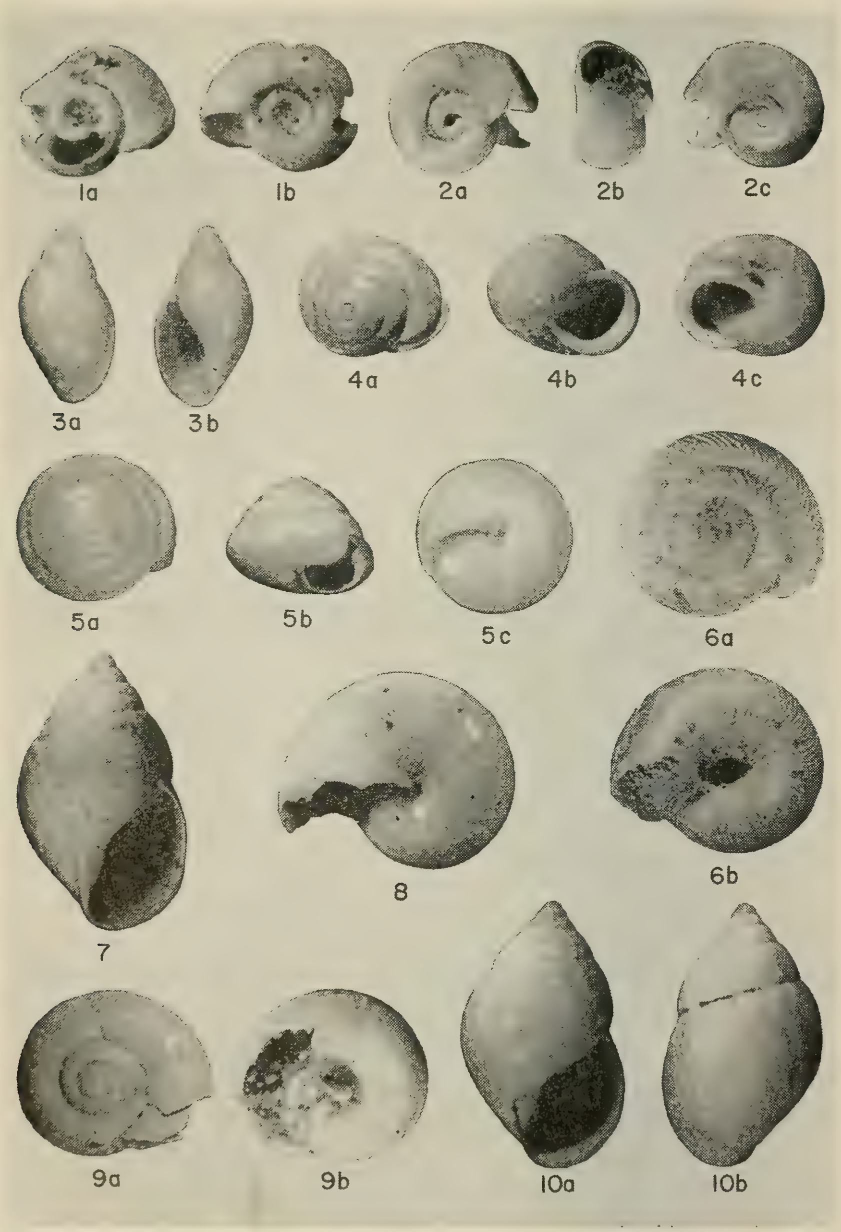
Figs. 10a-c.—*Gastrocopta contracta;* X 7.7; Fig. 10a, oblique apertural view showing umbilicus; Fig. 10b, apertural view; Fig. 10c, side view; Section 2, bed 5; U. S. N. M. No. 638756.

Fig. 11—*Succinea grosvenori;* X 2.1; apertural view; Section 2, bed 6; U. S. N. M. No. 638769.

Figs. 12a-c.—*Gastrocopta armifera;* X 7.4; Fig. 12a, oblique apertural view showing umbilicus; Fig. 12b, apertural view; Fig. 12c, side view; Section 2, bed 5; U. S. N. M. No. 638755.

Figs. 13a-c.—Seed of sedge genus *Scleria?* sp.; X 7.7; Figs. 13a, 13b, side views; Fig. 13c, view showing attachment scar; Section 2, bed 5; retained in Conkin Collection.

Fig. 14.—Snail egg; X 7.4; Section 2, bed 5; U. S. N. M. No. 638773.


1a
1b
2a
2b
2c
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4a
4b
4c
5a
5b
5c
6a
7
8
6b
9a
9b
10a
10b

Plate 2

Explanation of Plate 2

Figs. 1a, 1b.—*Armigerus obstructus;* X 7.5; Fig. 1a, dorsal view; Fig. 1b, umbilical view; Section 2, bed 5; U. S. N. M. No. 638772.

Figs. 2a-c.—*Helisoma tenue sinuosum;* X 2.1; Fig. 2a, dorsal view; Fig. 2b, apertural view; Fig. 2c, umbilical view; Section 2, bed 5; U. S. N. M. No. 638770.

Figs. 3a, 3b.—Physa sp.; Fig. 3a, side view; Fig. 3b, apertural view; Section 2, bed 5; U. S. N. M. No. 638771.

Figs. 4a-c.—*Praticolella berlandieriana;* X 2; Fig. 4a, dorsal view; Fig. 4b, apertural view; Fig. 4c, umbilical view; Section 2, bed 6; U. S. N. M. No. 638762.

Fgs. 5a-c.—*Euconulus chersinus trochulus;* X 7.5; Fig. 5a, dorsal view; 5b, apertural view; 5c, umbilical view; Section 2, bed 5; U. S. N. M. No. 638754.

Figs. 6a, 6b.—*Anguispira alternata;* X 1.6; Fig. 6a, apertural view; Fig. 6b, umbilical view; Section 2, bed 5; U. S. N. M. No. 638751.

Figs. 7, 10a, 10b.—*Bulimulus alternatus mariae;* X 1.6; Fig. 7, apertural view; Section 2, bed 6; U. S. N. M. No. 638752; Figs. 10a, 10b, immature specimen; Section 2, bed 6; U. S. N. M. 638753.

Fig. 8.—*Retinella indentata;* X 8.9; umbilical view; Section 2, bed 5; U. S. N. M. No. 638765.

Figs. 9a, 9b.—*Retinella indentata paucilirata;* X 6; Fig. 9a, dorsal view; Fig. 9b, umbilical view; Section 2, bed 5; U. S. N. M. No. 638766.

Systematic Paleontology

Anguispira alternata (Say)
Pl. 2, figs. 6a, 6b.

Description. Specimens fit the specific description of *Anguispira alternata* as given by Pilsbry (1948, p. 569); first one and one-half nuclear whorls smooth to faintly granulated; remaining whorls with moderately strong striations; periphery broadly angular. Specimens are weathered with color pattern showing only faintly.

Measurements. Measurements of *Anguispira alternata* are given in Table 1.

Distribution. Canada (Ontario to Nova Scotia); in the United States mainly east of the Plains (Pilsbry, 1948, p. 569).

Ecology. "*Anguispira alternata* is found under loose bark, dead wood, and in stone piles. Several observers have found it climbing trees . . . . *Anguispira alternata* is a plastic snail, varying from angular and heavily ribbed forms, in rocky or mountainous country, to rounded and finely or weakly striate shells in the lowlands . . . . A high-spired form is assumed in many places west to Kansas . . . . [apparently] owing to the moist air of such places which permits the snails to live both day and night out from under logs where the narrow quarters tend to keep the shell growth flattened" (Pilsbry, 1948, pp. 570-573).

Remarks. Pilsbry (1948, p. 569) reported *Anguispira alternata* to range from the Aftonian to the Recent in the Mississippi Valley; however, in the classic Kansas Pleistocene sequence it is known from only the post-Bradyan Bignell loess (Frye and Leonard, 1952, pp. 176, 182). The species has been reported from the loess at Natchez and Vicksburg by Shimek (1902), Richards (1938); in addition, Conkin and Conkin (1961, pp. 13-15) reported *A. alternata* from the loess at Vicksburg, Mississippi and have presented evidence for a post-Bradyan age for the upper 30 feet of the loess at Vicksburg. Browne and McDonald (1960) recorded *A. alternata* from the Tazewell deposits of Jefferson County, Kentucky.

Table 1. Measurements of *Anguispira alternata* in mm.

Specimen	Section and bed nos.	Length	Max. diam.	Min. diam.	Apert. height	Apert. width	No. of whorls
9, Pl. 2, figs. 6a, 6b	2, 5	10.0	17.9	16.0	7.5	7.2	5½
10	2, 5	11.0	18.0	16.2	8.2	8.1	5½
11	2, 5	10.0	16.2	15.0	7.0	7.5	5½

Armigerus obstructus (Morelet)
Pl. 2, figs. 1a, 1b.

Description. Shell, small; planispirally depressed; body whorl thickened behind the aperture; aperture fully rounded. Shell is white and it is strongly weathered.

Measurements. Measurements for *Armigerus obstructus* are given in Table 2.

Distribution. The genus is living in Bee County today (personal communication from Dr. J. P. E. Morrison).

Ecology. "Planorbulids are pulmonates, but rather well adapted to aquatic life in quiet waters" (Leonard, 1950, p. 17).

Remarks. Specific determination was made by Dr. J. P. E. Morrison. Only one fragmentary specimen was found in the samples. This is apparently the first report of the species from the fossil record.

Table 2. Measurements of *Armigerus obstructus* in mm.

Specimen	Section and bed nos.	Length	Max. diam.	Min. diam.	Apert. height	Apert. width	No. of whorls
76, Pl. 2, figs. 1a, b	2, 5	1.1	3.0	2.6	1.0	1.1	2½

Bulimulus alternatus mariae (Albers)
Pl. 2, fig. 7.

Description. Length and diameter agree with Pilbry's forms (1946, p. 14); however, apertures of our specimens are smaller; single blunt tooth distinctly outlined; several specimens retain their ragged gray stripes.

Measurements. Measurements of *Bulimulus alternatus mariae* are given in Table 3.

Distribution. This species is very commonly found in southwest Texas, and in northern Mexico in the states of Tamaulipas, Nuevo Leon, and San Luis Potosi (Pilsbry, 1946, p. 14).

Ecology. "This species [*Bulimulus alternatus mariae*] . . . . often occurs in great abundance, and sometimes, in aestivation, may be seen sealed to large cactus, mesquite, coarse grass and shrubs, and on fence posts, and telephone poles, even to the very top, in full glare of the hot sun" (Pilsbry, 1946, p. 15).

Remarks. Bulimulus alternatus mariae is herein reported for the first time in the fossil record.

Table 3. Measurements of *Bulimulus alternatus mariae* in mm.

Specimen	Section and bed nos.	Length	Diam.	Apert. height	Apert. width	No. of whorls
22, Pl. 2, figs. 10a, b	2, 10	22.7	22.0	8.9	8.4	5¾
24	2, 6	27.0	13.9	11.0	9.5	5½
25	2, 9	28.5	15.7	11.0	9.9	6¼
26	2, 6	27.6	15.2	11.1	11.0	6
27	2, 6	26.0	15.0	10.6	9.7	6
28, Pl. 2, fig. 7	2, 6	24.2	14.0	11.0	9.2	6
29	2, 10	27.0	14.9	11.2	10.0	6¾

Euconulus chersinus trochulus (Reinhardt)
Pl. 2, figs. 5a-c.

Description. Specimens are in essential agreement with specimens described by Pilsbry (1946, p. 242); however, present specimens possess 6¼ whorls.

Measurements. Measurements of *Euconulus chersinus trochulus* are given in Table 4.

Distribution. According to Pilsbry (1946, p. 242) *Euconulus chersinus trochulus* is known on the Gulf Coast from Texas and Louisiana, Arkansas, and Oklahoma.

Ecology. Euconulus chersinus trochulus is a southern species.

Remarks. Specific determination of this species was made by Dr. J. P. E. Morrison. This species is recorded from the fossil record for the first time.

Table 4. Measurements of *Euconulus chersinus trochulus* in mm.

Specimen	Section and bed nos.	Length	Max. diam.	Min. diam.	Apert. height	Apert. width	No. of whorls
73	2, 5	2.7	3.2	2.7	0.9	1.7	6¼
74, Pl. 2, figs. 5a-c	2, 5	2.3	2.9	2.6	0.6	1.3	6¼

Gastrocopta armifera (Say)

Pl. 1, figs. 12a-c.

Description. Franzen and Leonard (1947, p. 329) gave the range in measurements of their specimens as follows: height, 3.6-5.0 mm; diameter, 2.1-2.5 mm; apertural height, 1.4-1.8 mm; apertural width, 1.35-1.45 mm; number of whorls, 5½ to 7; however, present specimens are longer, narrower, with more whorls, and the apertures are smaller. Shells are weathered and white; there are six denticles.

Measurements. Measurements for *Gastrocopta armifera* are given in Table 5.

Distribution. "It [*Gastrocopta armifera*] inhabits almost the whole country east of the continental divide, but is lacking in southwestern New Mexico, southern Texas, southern Florida, and the higher parts of the Alleghany mountain system. It prefers limestone districts" (Pilsbry, 1948, p. 875).

Strecker (1935, p. 19) reported *Gastrocopta armifera* in Texas north and west of the Gulf Coastal Plain.

Ecology. "*Gastrocopta armifera* is a gregarious species occurring commonly on wooded slopes, near or removed from a stream. It is to be found under dead wood, limestone rocks, or light cover or leaf mold or other debris. *G. armifera* frequently occurs under boards or rocks in gardens" (Franzen and Leonard, 1947, p. 329).

Table 5. Measurements of *Gastrocopta armifera* in mm.

Specimen	Section and bed nos.	Length	Diam.	Apert. height	Apert. width	No. of whorls
37	2, 5	5.0	2.0	1.3	1.1	7¼
38	2, 5	4.9	2.0	1.2	1.0	7
39, Pl. 1, figs. 12a-c	2, 5	5.0	2.0	1.3	1.2	7
40	2, 5	5.0	1.9	1.3	1.1	7
41	2, 5	4.9	2.0	1.1	0.9	6¾
42	2, 5	5.0	2.0	1.3	1.1	7

"*Gastrocopta armifera* is distributed in North America in regions of diverse climates . . . . [and] is tolerant of, and adaptable to various climatic conditions. In the prolonged dry, hot summer months, *G. armifera* is able to aestivate, making possible its survival in Kansas, especially in the western part of the state, where the summer droughts are often severe" (Franzen and Leonard, 1947, p. 330).

Remarks. Gastrocopta armifera has previously been reported as a fossil from Texas only in the Yarmouthian from Roberts and Hartley counties in the Panhandle (Leonard, 1950, p. 29). The species is herein reported from the Gulf Coast of Texas for the first time in the fossil form; the species is apparently absent from the Recent snail fauna of the Gulf Coast.

Gastrocopta contracta (Say)

Pl. 1, figs. 10a-c.

Description. Description and measurements by Franzen and Leonard (1947, pp. 330, 331) fit our specimens. Shell is white with no trace of the original color preserved.

Measurements. Measurements for *Gastrocopta contracta* are given in Table 6.

Distribution. In Canada, Ontario and Manitoba; in the United States, from Maine to Florida, west to South Dakota, Kansas, Oklahoma, and to the mouth of the Pecos River in Texas; in Mexico, to Veracruz (Franzen and Leonard, 1947, p. 331).

Ecology. "On shaded slopes along the watercourses, under dead wood, leaf mold and grass" (Franzen and Leonard, 1947, p. 331).

Remarks. Gastrocopta contracta is herein reported for the first time as a fossil from Texas.

Table 6. Measurements of *Gastrocopta contracta* in mm.

Specimen	Section and bed nos.	Length	Diam.	Apert. height	Apert. width	No. of whorls
60, Pl. 1, figs. 10a-c	2, 5	2.7	1.5	1.0	0.8	5¾
61	2, 5	2.7	1.4	0.9	0.7	5¾
62	2, 5	2.3	1.2	1.0	0.9	5½
63	2, 5	2.2	1.3	0.9	0.8	5¾

Gastrocopta cristata (Pilsbry and Vanatta)

Pl. 1, figs. 7a-c.

Description. Shells striate; specimens similar to those described by Franzen and Leonard (1947, p. 345) from the Recent and Pleistocene except our forms are smaller than Franzen and Leonard's Pleistocene examples in regard to height, width, and apertural height and width. Compare measurements of *Gastrocopta cristata* in Table 7 with measurements of the forms given by Franzen and Leonard (1947, p. 345) from Meade County, Kansas: height, 2.35-3.5 mm; diameter, 1.35-1.40 mm; apertural height, 1.1-1.2 mm; apertural width, 0.7-1.0 mm. Specimens are pale yellow as a result of weathering.

Measurements. See Table 7 for measurements of *Gastrocopta cristata.*

Distribution. Pilsbry (1916, p. 68) gave the distribution of *Gastrocopta cristata* as northern Kansas, south to Oklahoma and southern Texas; west to New Mexico and Arizona.

Table 7. Measurements of *Gastrocopta cristata* in mm.

Specimen	Section and bed nos.	Length	Diam.	Apert. height	Apert. width	No. of whorls
56	2, 5	2.7	1.3	0.8	0.7	5¾
57	2, 5	3.0	1.2	0.9	0.8	6
58	2, 5	2.3	1.2	0.8	0.7	5½
59, Pl. 1, figs. 7a-c	2, 5	2.7	1.2	0.9	0.8	5¾

Ecology. "*Gastrocopta cristata* has, in Kansas, usually been found . . . on timbered slopes near streams. In Meade County [Kansas] it was found living in grassy meadowlands of the State Park (Leonard, 1943, p. 239)" (Franzen and Leonard, 1947, p. 345).

Remarks. *Gastrocopta cristata* is the most abundantly occurring species in the deposits at the Fordyce Quarry. Forsyth (1958, p. 10) recorded the species from the Yarmouthian of Texas.

Gastrocopta tappaniana (C. B. Adams)

Pl. 1, figs. 6a-c.

Description. Our specimens are in essential agreement with those of Franzen and Leonard (1947, pp. 336, 337) except the present forms have a larger average number of worls (5½ compared to an average number of worls of 4¾ as given by Franzen and Leonard).

Measurements. Measurements for *Gastrocopta tappaniana* are given in Table 8.

Distribution. Franzen and Leonard (1947, p. 337) reported the distribution of the species as follows: "Ontario; Maine to Virginia; west to South Dakota and Kansas, to Arizona (Pilsbry, 1916, Vol. 24, pt. 93, p. 33). Pleistocene of Nebraska and Kansas . . . . *Gastrocopta tappaniana*, essentially a northern species, entered Kansas sometime previous to Upper Pliocene times."

Ecology. "Its [*Gastrocopta tappaniana*] most frequent habitat is on shaded slopes near streams. However, it has been taken among grass roots on an unshaded slope near a pasture pond" (Franzen and Leonard, 1947, p. 337).

Remarks. This is the first report of *Gastrocopta tappaniana* from south Texas. The species has been reported from the Yarmouthian of Roberts and Hartley counties in the Panhandle of Texas by Leonard (1950, p. 32).

Table 8. Measurements of *Gastrocopta tappaniana* in mm.

Specimen	Section and bed nos.	Length	Diam.	Apert. height	Apert. width	No. of whorls
64, Pl. 1, figs. 6a-c	2, 5	2.0	1.0	0.6	0.5	5¼
65	2, 5	2.1	1.1	0.7	0.6	5¼
66	2, 5	1.9	1.0	0.5	0.5	5

Hawaiia minuscula (Binney)

Pl. 1, figs. 3a-c

Description. Specimens are in essential agreement with those described by Pilsbry (1946, p. 421) and Leonard (1950, p. 36).

Measurements. Measurements for *Hawaiia minuscula* are given in Table 9.

Distribution. In North America from Alaska and Maine to Florida and west to the Mountain States; Antilles, Japan, and Hawaii; England and Ireland in hot houses (Pilsbry, 1946, p. 421). Strecker (1935, p. 25) reported this species from the entire state of Texas.

Ecology. *Hawaiia minuscula* is tolerant of a wide range of climatic variations.

Remarks. Leonard (1950, p. 36) reported *Hawaiia minuscula* from the Lower Pliocene to the Recent, and from the Yarmouthian of Roberts and Hartley counties in the Panhandle of Texas.

Table 9. Measurements of *Hawaiia minuscula* in mm.

Specimen	Section and bed nos.	Length	Max. diam.	Min. diam.	Apert. height	Apert. width	No. of whorls
75, Pl. 1, figs. 3a-c	2, 5	1.1	2.2	2.0	0.3	0.5	4

Helicina orbiculata tropica "Jan" Pfeiffer

Pl. 1, figs. 2a-c.

Description. Shell finely striate; apertural lip reflected onto the body whorl with an apically developed thickening; small but prominent "tooth" at the junction of the columellar and basal margins. Shell, white with no color pattern preserved.

Measurements. Measurements for *Helicina orbiculata tropica* are given in Table 10.

Distribution. Southern species: Arkansas; Texas, eastern part, to the Pecos River in west Texas; Mexico, Coahuila, Tamaulipas, and Nuevo Leon (Pilsbry, 1948, p. 1084).

Ecology. Helicina orbiculata tropica is a rather well defined subspecies. It is able to withstand drouth; the species is found in the open areas as well as in the more vegetated areas.

Remarks. Helicina orbiculata tropica has been reported from the loess at Helena, Arkansas (Shimek, 1917), from the Wisconsinan of Bee and San Patricio counties, Texas (Sellards, 1940, p. 1637), and from the Berclair terrace of the Medio Creek in Bee County (Conkin and Conkin, 1962, p. 348).

Table 10. Measurements of *Helicina orbiculata tropica* in mm.

Specimen	Section and bed nos.	Length	Max. diam.	Min. diam.	Apert. height	Apert. width	No. of whorls
31	2, 5	7.0	8.5	7.2	3.1	2.0	4¾
32, Pl. 1, figs. 2a-c	2, 5	6.9	8.2	7.0	3.5	1.9	5
33	2, 5	6.9	8.0	6.9	3.5	2.1	5
34	2, 5	6.5	8.0	6.7	3.5	2.0	5
35	2, 5	6.5	7.6	6.2	3.1	2.0	5
36	2, 5	6.5	7.8	6.5	3.5	2.0	4¾

Helisoma tenue sinuosum (Bonnet)

Pl. 2, figs. 2a-c.

Description. The present examples are apparently normal for the species.

Measurements. Measurements for *Helisoma tenue sinuosum* are given in Table 11.

Distribution. Helisoma tenue sinuosum is apparently a south Texas species.

Ecology. "Gastropods belonging to the genus *Helisoma* are inhabitants of stagnant ponds, small lakes, and the quieter waters of streams" (Leonard, 1950, p. 15).

Remarks. Specific determination was made by Dr. J. P. E. Morrison. This is apparently the first record of *Helisoma tenue sinuosum* from the fossil record.

Table 11. Measurements of *Helisoma tenue sinuosum* in mm.

Specimen	Section and bed nos.	Length	Max. diam.	Min. diam.	Apert. height	Apert. width	No. of whorls
7, Pl. 2, figs. 2a-c	2, 5	5.5	10.2	8.6	5.2	3.0	4
8	2, 5	8.0	15.1	11.0	7.0	5.0	4

Physa sp.

Pl. 2, figs. 3a, 3b.

Description. Shell has a thin callus which is reflected onto the body whorl; body whorl is three-fourths of the total height of the shell; present specimen is small.

Measurements. Measurements for *Physa sp.* are given in Table 12.

Distribution. Widespread.

Ecology. "*Physa* is a genus of pond or small-stream snail, usually found in quiet or stagnant water, but some species occur in swift, clear streams . . . it dates from the Cretaceous of North America" (Leonard, 1950, p. 21).

Remarks. Present specimen probably represents an immature form.

Table 12. Measurements of *Physa* sp. in mm.

Specimen	Section and bed nos.	Length	Diam.	Apert. height	Apert. width	No. of whorls
77, Pl. 2, figs. 2a, b	2, 5	3.5	1.9	1.6	0.8	3

Polygyra texasiana (Moricand)

Pl. 1, figs. 4a-c.

Description. Specimens are in essential agreement with those of Pilsbry (1940, p. 617).

Measurements. Measurements for *Polygyra texasiana* are given in Table 13.

Distribution. Polygyra texasiana is characteristically a southern species occurring in Arkansas, Oklahoma, and Louisiana; in Texas, east, south, southwest, and central (Pilsbry, 1940, p. 617).

Ecology. "*Polygyra texasiana* lives in timbered areas, under leaves, logs, and stones" (Leonard, 1950, p. 35).

Remarks. Polygyra texasiana has been reported in the Yarmouthian and Aftonian by Leonard (1950, p. 35). Conkin and Conkin (1962, p. 351) have recorded the species from the Pliocene.

Table 13. Measurements of *Polygyra texasiana* in mm.

Specimen	Section and bed nos.	Length	Max. diam.	Min. diam.	Apert. height	Apert. width	No. of whorls
12	2, 5	5.9	9.7	8.0	4.0	3.0	5½
13, Pl. 1, figs. 4a-c	2, 5	4.5	9.4	8.0	4.0	2.8	5
14	2, 5	5.1	11.0	9.0	4.2	3.0	5½
15	2, 5	5.0	9.9	8.5	4.0	2.9	5½
16	2, 5	4.1	9.5	8.1	4.0	3.0	5¼
17	2, 5	4.0	9.0	7.7	4.0	2.7	5¼

Praticolella berlandieriana (Moricand)

Pl. 2, figs. 4a-c.

Description. Shell finely, but unevenly striate; otherwise present specimens are in essential agreement with those of Pilsbry (1940, p. 694). Shells are white with no color pattern preserved.

Measurements. Measurements for *Praticolella berlandieriana* are given in Table 14.

Distribution. Praticolella berlandieriana is a southern species occurring in Arkansas, and central and southern Texas; in Mexico, Tamaulipas and Nuevo Leon (Pilsbry 1940, p. 694).

Ecology. This is a southern species occurring in moderately dry to semiarid country.

Remarks. The first record of *Praticolella berlandieriana* as a fossil is that of Conkin and Conkin (1961, p. 12) in which it was reported as a fragment questionably referred to *P. berlandieriana* from the upper 30 feet of the loess at Vicksburg, Mississippi. The species has been reported also from the Wisconsinan of Bee County, Texas (Conkin and Conkin, 1962, p. 348).

Table 14. Measurements of *Praticolella berlandieriana* in mm.

Specimen	Section and bed nos.	Length	Max. diam.	Min. diam.	Apert. height	Apert. width	No. of whorls
18	2, 6	8.2	10.0	8.5	5.5	4.1	4¾
19, Pl. 2, figs. 4a-c	2, 6	8.8	10.5	8.9	6.2	4.5	5¼
20	2, 6	8.5	10.0	8.1	5.5	3.9	4¾

Pupilla blandi Morse

Pl. 1, figs. 8a, 8b.

Description. Present specimens are in essential agreement with those forms described by Pilsbry (1948, p. 931). Shell is white with original color pattern not preserved.

Measurements. Measurements for *Pupilla blandi* are given in Table 15.

Distribution. Pilsbry (1948, p. 931) gave the distribution of *Pupilla blandi* as follows: "Rocky Mountain region, from Montana and Red Deer, Alberta, to New Mexico; west to Nevada; eastward in the semiarid region (mainly as a fossil or in river drift) to McLean Co., North Dakota (at Ft. Berthold, type loc.); Brule Co., South Dakota; Phillips Co., Kansas; Comal Co., Texas."

Ecology. Leonard (1950), p. 28) discussed the ecology of *Pupilla blandi*: "It has disappeared from the Great Plains province, and occurs in regions of higher humidity and lower mean temperature. In the southern part of its range [see paragraph above on distribution] it lives at altitudes up to 10,000 feet, especially in aspen groves."

Remarks. Except for Pilsbry's (1948, p. 933) reference to *Pupilla blandi* either as a fossil washed from Pleistocene deposits on the river banks, or in river drift in Comal County, Texas, the species is not previously known from the geologic column of Texas, and does not occur in Texas today. This species is good evidence for a cool and humid climate during the deposition of the Wisconsinan deposits of the Fordyce Quarry, and the subsequent trend to warmth and aridity on the Gulf Coast of Texas since the Wisconsinan.

Table 15. Measurements of *Pupilla blandi* in mm.

Specimen	Section and bed nos.	Length	Diam.	Apert. height	Apert. width	No. of whorls
43	2, 5	3.0	1.2	1.1	0.9	6½
44, Pl. 1, figs. 8a, b	2, 5	3.1	1.5	0.9	0.8	5¾
45	2, 5	3.0	1.6	1.0	0.8	6¼
46	2, 5	2.9	1.3	0.9	0.7	6¼
47	2, 5	3.0	1.7	0.8	0.7	6¼

Pupoides albilabris (C. B. Adams)

Pl. 1, figs. 9a, 9b.

Description. Specimens are in essential agreement with those forms described by Pilsbry (1948, pp. 921-923), but the apertural height and width of our forms are smaller than those of Franzen and Leonard's forms (1947, p. 370): apertural height, 1.5-2.0 mm; apertural width, 1.4-1.6 mm.

Measurements. Measurements for *Pupoides albilabris* are given in Table 16.

Distribution. "Maine and Ontario, south to the Gulf of Mexico, west to the Dakotas, western Arizona; northeastern Mexico to Cuba, Haiti, San Domingo, Porto Rico, Bermuda (Pilsbry, 1921, Vol. 26, pt. 102, p. 111" (Franzen and Leonard, 1947, p. 371).

Ecology. "*Pupoides albilabris* is tolerant of a wide range in environmental conditions; it thrives in woodlands under leaf mold, loosened bark of dead trees, beneath stones, and in prairies in dead grass, or even in short-grass pastures in unshaded situations" (Leonard, 1950, p. 29).

Remarks. Leonard (1950, p. 29) gave the geologic range of *Pupoides albilabris* as Pliocene to Recent and the species as a fossil in Texas only from the Yarmouthian of the Panhandle.

Table 16. Measurements of *Pupoides albilabris* in mm.

Specimen	Section and bed nos.	Length	Diam.	Apert. height	Apert. width	No. of whorls
52	2, 5	4.8	2.0	1.4	1.3	5¾
53	2, 5	4.5	1.9	1.3	1.2	5¾
54, Pl. 1, figs. 9a, b	2, 5	4.1	2.0	1.3	1.2	5¾
55	2, 5	4.4	2.0	1.3	1.1	5¾

Retinella indentata (Say)

Pl. 2, figs. 8, 9a, 9b.

Description. Specimens are shorter, narrower, and have fewer whorls than those forms described by Pilsbry (1946, p. 289): height, 3.0 mm; diameter, 5.7 mm; and whorls, 4⅔.

Measurements. Measurements for *Retinella indentata* are given in Table 17.

Distribution. Canada, Ontario north to the Muskoka District, Manitoulin Island and Ottawa. In the United States, New England and Middle States; Virginia, West Virginia, Ohio, and Michigan; west to Kansas; east and north Mis-

souri; Tennessee, and northern Alabama (Pilsbry, 1946, p. 289). *Retinella indentata* is known from the entire state of Texas (Strecker, 1935, p. 24).

Ecology. Retinella indentata is a cosmopolitan species. Baker (1939, p. 71) discussed the ecology of *R. indentata* as found in Illinois: "It may be found living in almost every county in the state. It is found in the river valleys, in wooded areas and in former prairie lands, associated with *Retinella electrina, Zonitoides arboreus* and other small snails. Its most favorable habitat, like that of so many small snails of the state, is in woodlands of oak, elm, maple, and hickory. It may be found under loose bark, woodland debris and fallen limbs of trees."

Table 17. Measurements of *Retinella indentata* in mm.

Specimen	Section and bed nos.	Length	Max. diam.	Min. diam.	Apert. height	Apert. width	No. of whorls
72, Pl. 2, fig. 8	2, 5	2.7	4.5	3.9	2.0	2.5	4

Remarks. Retinella indentata is known from the Yarmouthian to the Recent (Forsyth, 1958, p. 8). The species was recorded in Texas for the first time as a fossil (Wisconsinan) by Conkin and Conkin (1962, p. 348). Conkin and Conkin (1961, p. 12) reported *R. indentata* from the upper 30 feet (Wisconsinan) of the loess at Vicksburg, Mississippi.

Retinella indentata paucilirata (Morelet)

Pl. 2, figs. 9a, 9b.

Description. Retinella indentata paucilirata differs from *R. indentata* in having a larger umbilicus.

Measurements. Measurements for *Retinella indentata paucilirata* are given in Table 18.

Distribution. This species is recorded as distributed from Guatemala northward to southern Indiana (Pilsbry, 1946, p. 291).

Ecology. This species is characteristically one of southern to south-temperate zones.

Remarks. Specific determination was made by Dr. J. P. E. Morrison. *Retinella indentata paucilirata* has been recorded from the loess at Helena, Arkansas (Shimek, 1917), Natchez (Shimek, 1902), Vicksburg (Shimek, 1902 and Richards, 1938), and at Tunica, Louisiana (Richards, 1938).

Table 18. Measurements of *Retinella indentata paucilirata* in mm.

Specimen	Section and bed nos.	Length	Max. diam.	Min. diam.	Apert. height	Apert. width	No. of whorls
71, Pl. 2, figs. 9a, b	2, 5	2.5	3.7	2.9	1.4	1.9	3¾

Stenotrema leai aliciae (Pilsbry)

Pl. 1, figs. 1a-c.

Description. Specimens are larger than those described from Michigan and Ohio by Pilsbry (1940, p. 680).

Measurements. Measurements for *Stenotrema leai aliciae* are given in Table 19.

Distribution. Iowa, Kansas, Missouri, Arkansas, Oklahoma, Texas (Bowie, Cooke, Dallas, and Wood counties), Mississipppi, Alabama, Tennessee, Kentucky, Illinois, and Indiana. East Texas to Virginia, and Washington, D. C. (Pilsbry, 1940, p. 680).

Ecology. Stenotrema leai aliciae is characteristically a snail of the humid lowlands, but has been found at 4,000 feet elevation in Virginia (Pilsbry, 1940, p. 680).

This species has been reported from the late Wisconsinan Berclair terrace of Bee County, Texas by Conkin and Conkin (1962, p. 348). Forsyth (1958, p. 8) records *Stenotrema leai aliciae* from the Caryan of the Wisconsinan in Illinois.

Table 19. Measurements of *Stenotrema leai aliciae* in mm.

Specimen	Section and bed nos.	Length	Max. diam.	Min. diam.	Apert. height	Apert. width	No. of whorls
1, Pl. 1, figs. 1a-c	2, 5	6.4	9.1	8.1	3.1	5.5	6
2	2, 5	5.5	8.7	8.2	3.1	5.0	5¾
3	2, 5	5.4	8.8	8.0	2.9	4.6	5½
4	2, 5	5.5	8.7	8.1	3.0	4.6	5½
5	2, 5	5.6	8.3	7.9	3.0	4.6	5¾
6	2, 5	5.2	8.7	7.9	3.0	4.5	5½

Strobilops texasiana (Pilsbry and Ferriss)

Pl. 1, figs. 5a-c.

Description. Specimens are in essential agreement with those forms described by Pilsbry (1948, pp. 858-860).

Measurements. Measurements for *Strobilops texasiana* are given in Table 20.

Distribution. Strobilops texasiana is known from southwest, south, and northeast Texas and Louisiana, Arkansas, and Oklahoma (Pilsbry, 1948, p. 858).

Ecology. Leonard (1950, p. 34) commented on the ecological requirements of *Strobilops* as follows: "The genus *Strobilops* comprises small snails which live on decaying logs and dead leaves in moderately humid forests. It is distributed in North America from the 100th meridian eastward; it ranges from Ontario, Canada, on the north to Guatemala."

Remarks. "In Europe, a number of fossil species are known from Eocene to Pliocene, when the genus became extinct there. The genus is sporadically distributed over the world elsewhere. In North America, *Strobilops* appears first in Aftonian faunas." (Leonard, 1950, p. 34).

Strobilops texasiana has been reported from the drift along the Guadalupe River in Comal County, Texas (Pilsbry, 1948, p. 858). Otherwise, this is apparently the first record of the species in the Pleistocene.

Table 20. Measurements of *Strobilops texasiana* in mm.

Specimen	Section and bed nos.	Length	Max. diam.	Min. diam.	Apert. height	Apert. width	No. of whorls
67	2, 5	2.0	2.3	2.1	0.8	1.0	5½
68	2, 5	2.1	2.4	2.2	0.9	1.1	5½
69, Pl. 1, figs. 5a-c	2, 5	2.0	2.8	2.2	0.8	1.0	5¾
70	2, 5	2.1	2.5	2.2	0.9	1.1	5¾

Succinea grosvenori Lea

Pl. 1, fig. 11.

Description. Specimens are in essential agreement with those of Pilsbry (1948, pp. 820-822) and Leonard (1950, p. 24).

Measurements. Measurements for *Succinea grosvenori* are given in Table 21.

Distribution. "It [*Succinea grosvenori*] occurs from the warm humid Golf Coast to semi-arid areas in the great plains and mountain states, and in British America it extends north within the border of Northwest Territory" (Pilsbry, 1948, p. 821).

Ecology. "*S. grosvenori,* as now understood, tolerates an astonishingly wide range in practically all external conditions." (Pilsbry, 1948, p. 821.)

Remarks. Leonard (1950, p. 24) records *Succinea grosvenori* from the Aftonian of the Panhandle of Texas; the overall geologic range of the species was given as Aftonian to Recent.

Specific determination of this species was made by Dr. J. P. E. Morrison.

Table 21. Measurements of *Succinea grosvenori* in mm.

Specimen	Section and bed nos.	Length	Diam.	Apert. height	Apert. width	No. of whorls
48	2, 7	12.0	6.0	6.2	5.0	3¾
49	2, 7	10.2	5.8	6.0	4.2	3½
50	2, 6	10.1	5.3	5.8	4.1	3¼
51, Pl. 1, fig. 11	2, 6	12.9	6.9	8.0	5.8	3¾

Land Snail Egg

Pl. 1, fig. 14.

Description. Egg nearly spherical; calcified wall, hollow interior; color is buff; average diameter of three specimens is 4.5 mm.

Remarks. We were not able to identify the eggs further.

Scleria? sp.

Pl. 1, figs. 13a-c.

Description. No description of this seed is attempted at this time; maximum diameter of seed is 4.5 mm, and minimum diameter is 4.0 mm.

Remarks. We are indebted to Mr. Bob Gunn of the Department of Botany, Iowa State University, Ames, Iowa, for a tentative identification of this fossil seed of the sedge genus *Scleria?* Sedge are in themselves indicative of most ecological stations.

Literature Cited

Baker, F. C. 1939. Fieldbook of Illinois land snails. Illinois Nat. Hist. Surv., Manual 2, 116 pp. Urbana.

Browne, R. G. and D. E. McDonald. 1960. Wisconsinan molluscan faunas from Jefferson County, Kentucky. Bull. American Paleont. 41: 165-183.

Conkin, J. E. and B. M. Conkin. 1961. Fossil land snails from the loess at Vicksburg, Mississippi. Trans. Kentucky Acad. Sci. 22: 11-15.

————. 1962. Pleistocene Berclair terrace of Medio Creek, Bee County, Texas. Bull. American Assoc. Petrol. Geol. 46: 344-353.

Forsyth, J. L. 1958. Pleistocene non-marine Mollusca of eastern United States. Unpublished manuscript, Ohio Geol. Surv. 22 pp. Columbus.

Franzen, D. and A. B. Leonard. 1947. Fossil and living Pupillidae (Gastropoda-Pulmonata) in Kansas. Univ. Kansas Sci. Bull. 30: 311-411.

Frye, J. C. and A. B. Leonard. 1952. Pleistocene Geology of Kansas. Kansas Geol. Surv., Bull. 99, 230 pp.

Leonard, A. B. 1950. A Yarmouthian molluscan fauna in the midcontinent region of the United States. Univ. Kansas Paleont. Contrib., Mollusca, Art. 3: 1-48.

Pilsbry, H. A. 1940. Land Mollusca of North America (North of Mexico). Monograph No. 3, The Acad. Sci. Philadelphia. 1 (2).

————. 1946. Land Mollusca of North America (North of Mexico). Monograph No. 3, The Acad. Sci. Philadelphia. 2 (1).

————. 1948. Land Mollusca of North America (North of Mexico). Monograph No. 3, The Acad. Sci. Philadelphia. 2 (2).

Richards, H. G. 1938. Mollusks from the loess at Tunica, Louisiana. Louisiana Geol. Surv. 12: 47-58.

Sellards, E. H. 1940. Pleistocene artifacts and associated fossils from Bee County, Texas. Geol. Soc. America, Bull. 51: 1627-1658.

Shimek, B. 1902. The loess of Natchez, Mississippi. American Geol. 30: 279-299.

————. 1917. The loess of Crowley's Ridge, Arkansas. Iowa Acad. Sci., Proc. 23: 147-152.

"LOST" SPECIES OF KENTUCKY LILIACEAE

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During the course of some investigations of the Liliaceae of Kentucky, several species have been found on deposit in herbaria which were collected no more recently than 50 or 100 or more years ago. It is not known whether these species still occur in the state. In addition, there are several other species in the Liliaceae which would be expected to occur in the state on the basis of their reported distribution in adjacent states but of which there are no known records (Small, 1933; Greenwell, 1935; Deam, 1940; Steyermark, 1940; McFarland, 1942; Braun, 1943; Fernald, 1950; Gleason, 1952; Strausbaugh and Core, 1952; Jones and Fuller, 1955; McGilliard, 1955; and Mohlenbrock and Voigt, 1959). Therefore, whether a species has not been reported from the state for a long period of time or botanists have failed to collect and report it, the species is effectively lost or unknown to botanical science as far as its occurrence in this state is concerned. There are examples of the former type on record for other states the best known of which is that of *Franklinia Altamaha* Marsh. in Georgia.

Probably the most important example of a "lost" species of Liliaceae in Kentucky is *Smilacina stellata* (L.) Desf. As the writer has pointed out in a previous paper, S. *stellata* was collected during the last century, but no record is known of its occurrence in the state in the 20th century or possibly in 100 years or more. (Browne, 1961). In spite of repeated attempts on the part of the writer and his colleagues to relocate S. *stellata*, there has been no success.

The record of the occurrence of this species in the state is as follows:

(Jefferson Co.). Corn Island, Louisville, C. W. Short, M.D., s.n. Kentucky, 1840. (PH 783418)

(Jefferson Co.). In sylvis. Louisville, Ky. s.d. C. Mohr, 2921. (MO 147191)

(? Co.). Kentucky, 1840. C. W. Short, M.D., s.n. (GH, PH, NY)

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Corn Island is situated in the Ohio River at Louisville. It has undergone considerable physical change associated with dam and canal construction, and the locality in which this species once occurred is thought to exist no longer. Growth of the metropolitan area of the city of Louisville has resulted in total destruction of the natural vegetation of great areas in the vicinity. It would appear, therefore, that all the former stations of this species in the area have been destroyed. If this species now occurs elsewhere in Kentucky, it is not known.

Among the manuals, only the second edition of Britton and Brown's Illustrated Flora (1913) reports the species for Kentucky. It is possible that the species may be found in Henderson and Union Counties since Deam (1940) reports it from Posey Co., Indiana, which is across the Ohio River from these counties.

On the basis of the distribution of *Amianthium muscaetoxicum* (Walt.) Gray, crow poison, in Campbell Co., Tennessee (McGilliard, 1955), it was suspected that this species might also occur in Kentucky since this county is adjacent to the state. Only two records are known of its occurrence in the state, however, and each of these is 122 years old. Apparently on the basis of these specimens the species is indicated in Gray's Manual, 7th ed., (Robinson and Fernald, 1908) and the New Britton and Brown (Gleason, 1952) to occur in Kentucky. It is not exactly clear what is included in the range given the species in Gray's Manual, 8th ed., (Fernald, 1950) which reads: "Fla. to s. Mo. and Okla., n. along the mts. to W. Va. and Pa." This could include Kentucky except that the only previous reports of the species have not been from the mountains. In addition, Britton and Brown (1913) give the range as: ". . . Long Island and eastern Pennsylvania to Florida, Tennessee, Missouri and Arkansas." It is not possible to determine whether Kentucky was meant to be included, nor is it possible to tell what is included in the distribution of the species given by Small (1903, 1933). In the manuals, when a species is no longer thought to be present in an area, it is customary to so indicate by the use of expressions such as "formerly in such and such an area" or by similar terminology. For both this species and *Smilacina stellata* no such reference is made in one of the more recent manuals (Fernald, 1950).

The only collections of *A. muscaetoxicum* from Kentucky known to exist are the following:

Todd Co. Meadows and barrens near Elkton. June 5th 1840. C. W. Short, M.D., s.n. (PH 784795)

(? Co.). Barrens of Kentucky. May 1840. C. W. Short, M.D., s.n. (PH, NY)

The problem concerning the existence of this species in Kentucky today is one of the most interesting at the present time. Field work is planned in Todd Co. in the near future in order to help answer the question of its occurrence in the state.

Distributional data given for *Melanthium virginicum* L. in Small (1903, 1933), Robinson and Fernald (1908), Britton and Brown (1913), Fernald (1950) and Gleason (1952) leave no doubt that the species occurs in Kentucky. It is of significance, however, that all of these reports are apparently based upon one collection, that of C. W. Short. No others have been located in herbaria. Whether this species still occurs in the state is problematic since the one known collection was made 120 years ago. Deam (1940) gives Floyd Co., Indiana, as one locality of this species, and since this county is across the Ohio River from Louisville, this information should be of some help in attempting to relocate the species.

The following specimens are cited as the Kentucky records:

(? Co.). 1842. C. W. Short, M.D., s.n. (Two sheets, NY)

Another species of Liliaceae which has been collected in the state only once and which has not been reported since is *Xerophyllum asphodeloides* (L.) Nutt. This species has a very scattered distribution in the eastern United States, and it appears to be found mainly in dry habitats of the pine barrens of the Coastal Plain in "New Jersey, Delaware and North Carolina" and in similar situations on mountain sides and mountain tops from "Virginia to Georgia and Tennessee" (Fernald, 1950). Its occurrence in south-central Kentucky is somewhat of a puzzle in plant distribution, and in spite of attempts to do so, it has not been possible to relocate it. Based on both floral characteristics and length of the pedicels, the specimen cited below can only be *X. asphodeloides*. Its only known occurrence in the state is represented by the following specimen:

(Warren Co.). Bowling Green. 1903. Sadie F. Price, s.n. (MO)

This species might most reasonably be expected to occur in the Cumberland Plateau Province of eastern Kentucky since Robinson and Fernald (1908) and Britton and Brown (1913) describe its distribution as: ". . . N. J. to e. Tenn. and Fla.", and more recently Gleason (1952) has given the distribution to be: ". . . N. J.; . . . Va. to Tenn. and N. C." Its rediscovery in Kentucky would be a great find.

In the second category of "lost" species of Liliaceae in Kentucky are the following species which have never been reported from the state and which, as far as can be determined on the basis of specimens

deposited in herbaria, have not been collected in the state: *Convallaria montana* Raf., *Helonias bullata* L., *Maianthemum canadense* Desf., *Melanthium hydridum* Walt., *Muscari racemosum* (L.) Mill., *Schoenolirion croceum* Gray, *Tofieldia glutinosa* (Michx.) Pers., *Veratrum viride* Ait., *Yucca filamentosa* L., and *Zigadenus leimanthoides* Gray.

The question of the validity of *Convallaria montana* Raf. as a species is undecided. Fernald (1950) considers it to be distinct from *C. majalis* L., and the writer is inclined to agree with this treatment. Whatever the relationship is, neither *C. montana* nor *C. majalis* has been reported as a wild plant from Kentucky. The native *C. montana,* which differs morphologically in several respects from *C. majalis* and grows singly or in small groups as opposed to the large colonies formed by *C. majalis,* is a plant of the higher altitudes, and, based on its distribution in West Virginia, Virginia and Tennessee, it might also be found in eastern Kentucky. No records are known of its occurrence there, however. In addition, there are no indications to be found in the literature concerning its distribution in Kentucky.

There is reason to believe that *Helonias bullata* L. might also be found in Kentucky, but there are no records to indicate its former or present occurrence. Since this species is distributed in the "mountains of Pennsylvania to nw. Georgia" (Fernald, 1950), there is the likelihood that *H. bullata* may be found in bogs at higher elevations in the eastern part of the state. Since one of the main purposes of this paper is to point out plant species of probable occurrence in the state so that others may be on the lookout for them, the inclusion of this species here is desirable.

It would not be at all surprising if *Maianthemum canadense* Desf. were discovered somewhere in the state. This species is to be found in four adjacent states, Indiana, West Virginia, Virginia and Tennessee, and its occurence here might be implied on this basis. However, no specimens of this species have been seen from Kentucky in herbaria nor have any collections of it been made by the writer or his colleagues. The range given by Fernald (1950) would exclude Kentucky, but in Small's Flora (1903), the 2nd edition of Britton and Brown (1913), Gray's Manual, 7th ed. (Robinson and Fernald, 1908), and Small's Manual (1933) Kentucky would seem to be included within the range. In Small (1903) and Britton and Brown (1913) this is given as: "Newfoundland to the Northwest Territory, south to North Carolina, Tennessee, Iowa and South Dakota", and in Gray's Manual, 7th ed. (Robinson and Fernald, 1908) the distribution reads: ". . . Lab. to N. C. w. to Ia., Dak. and Man." Belief that this species may occur in Kentucky is further strengthened by the fact that Deam (1940)

reports *M. canadense* from Floyd Co., Indiana, and this locality is across the Ohio River from Louisville.

Muscari racemosum (L.) Mill. would appear to occur in Kentucky since, according to Small (1933), the species is distributed from "N.C. to Miss., Md. and N.Y.", Fernald (1950) gives its range as: "Mass. to Mich., s. to Ga. and Miss." and Gleason (1952) says: ". . . Mass. to N.C. and Ind." No records are to be found to substantiate its presence in the state, however. It is easily separated from *M. botryoides* (L.) Mill., which is found in Kentucky (Greenwell, 1935), by its narrow, grass-like leaves as opposed to the wider, more flattened leaves of *M. botryoides.* Since *M. racemosum* is cultivated in Kentucky, it is reasonable to expect that it would be found in the wild also.

Schoenolirion croceum Gray occurs on the cedar barrens of central Tennessee (McGilliard, 1955). While this species is not known to occur in Kentucky, it is believed that it might be found in the barrens of south-central Kentucky, and investigation of these areas may reveal its presence. It is not now known from the literature or its presence in herbaria from this state.

No record is to be found in herbaria or in the literature of the occurrence of species of the genus *Tofieldia* in Kentucky. One species, however, might be expected to occur in the state. Since *T. glutinosa* (Michx.) Pers. is found in Ohio, West Virginia, Virginia, North Carolina and Georgia (Small, 1903, 1933; Fernald, 1950; Gleason, 1952). this species may be found in the mountainous eastern part of the state.

The American or white hellebore, *Veratum viride* Ait., would be expected to be found in Kentucky based on the distribution of this species in West Virginia, Virginia and Tennessee (Small, 1903, 1933; Britton and Brown, 1913; Fernald, 1950; Gleason, 1952). There are no known herbarium specimens in existence, however, or reports in the literature to support inclusion of this species in the Kentucky flora. Should this species be found in the state, it is probable that its occurrence would be in the mountains of eastern and southeastern Kentucky.

Several reports are to be found in the literature concerning the presence of *Yucca filamentosa* L. (Greenwell, 1935; McFarland, 1942; Braun, 1943), and, while these reports may be correct, it is highly doubtful. During 1961, *Yucca* was collected in several localities in the state, but the species which was found was always *Y. Smalliana* Fern. (Browne, 1961). Since no herbarium specimens of *Y. filamentosa* were seen, it is reasonable to believe that although this species may grow wild in the state, it is not as common as the very similar *Y. Smalliana* upon which the earlier reports may have been based. Persons inter-

ested in the botany of Kentucky should be on the lookout for *Y. filamentosa* since it has unquestionably escaped in other states and should be expected to do so here although it is at present not known for the state with certainty.

Zigadenus leimanthoides Gray is included in this discussion on the basis of its distribution in the following states adjoining Kentucky: Indiana, West Virginia and Tennessee (Deam, 1940; Strausbaugh and Core, 1952; McGilliard, 1955). The known distribution in these states is such that there is not a very strong indication of its occurrence here. Nevertheless, to fail to look for this species in the state would be unwise since already several quite unexpected finds have been made, e.g., *Trillium pusillum* Michx. (Browne, 1961).

One of the major lines of investigation in the future will be the continued search for the above-named species. Since the botany of Kentucky is still so incompletely known, it may be that some or all of these species will be eventually found. The writer welcomes information and/or inquiries from interested parties concerning these species.

In connection with this work, examination of specimens of Liliaceae was made in the following herbaria: University of Kentucky, Department of Botany, University of Kentucky Agricultural Experiment Station, University of Cincinnati, the E. Lucy Braun Herbarium, United States National Herbarium, Academy of Natural Sciences, Philadelphia (PH), Gray Herbarium (GH), Arnold Arboretum Herbarium, Missouri Botanical Garden Herbarium (MO), and the New York Botanical Garden Herbarium (NY). The writer wishes to express his appreciation to the curators and staffs of these institutions for their cooperation in making examination of specimens possible.

Literature Cited

Braun, E. Lucy. 1943. An annotated catalog of the Spermatophytes of Kentucky. The Author, Cincinnati.

Britton, N. L., and A. Brown. 1913. An illustrated flora of the northern states. ed. 2. N. Y. Botanical Garden, New York.

Browne, E. T. 1961. Some new or otherwise interesting reports of Liliaceae from the southeastern states. Rhodora 63(755): 304-311.

Deam, C. C. 1940. Flora of Indiana. Department of Conservation, Indianapolis.

Fernald, M. L. 1950. Gray's manual of botany. ed. 8. American, New York.

Gleason, H. A. 1952. The new illustrated Britton and Brown. N. Y. Botanical Garden, New York.

Greenwell, Sr. Rose Agnes. 1935. A flora of Nelson County, Kentucky. Nazareth College, Louisville.

Jones, G. N., and G. D. Fuller. 1955. Vascular plants of Illinois. University of Illinois Press, Urbana, and Illinois State Museum, Springfield.

McFarland, F. T. 1942. A catalogue of the vascular plants of Kentucky. Castanea 7: 77-108.

McGilliard, E. 1955. The family Liliaceae in Tennessee. Jour. Tenn. Acad. Sci. 30: 19-26.

Mohlenbrock, R. H., and J. W. Voigt. 1959. A flora of southern Illinois. Southern Illinois University Press, Carbondale.

Robinson, B. L., and M. L. Fernald. 1908. Gray's new manual of botany. ed. 7. American, New York.

Small, J. K. 1903. Flora of the southeastern states. The Author, New York.

Small, J. K. 1933. Manual of the southeastern flora. The Author, New York.

Steyermark, J. A. 1940. Spring flora of Missouri. Mo. Botanical Garden, St. Louis, and Field Museum, Chicago.

Strausbaugh, P. D., and E. L. Core. 1952. Flora of West Virginia. Part I. West Virginia University, Morgantown.

A PHENOMENOLOGICAL CHARACTERISTIC OF THE AUDITORY STIMULUS

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Audition and vision constitute our two most important distance senses. Through these sensory modalities we receive advance notice of our physical environment before we actually come in contact with it. Despite the fact that light and sound may be conceptualized by wave theory, there are fundamental and significant differences between them psychophysically. To amplify this point, several comparisons are offered. Whereas the wavelength of audible sound may be measured in inches or feet, the wavelength of the visual stimulus is measured in millimicrons. Whereas, under certain conditions, the auditory system can analyze a complex sound into its component harmonics, the visual system cannot distinguish between the wavelengths of reflected light from an object even when all the visible wavelengths are present. This paper will call attention to a heretofore unspecified phenomenological difference between visual and auditory perception and offer a tentative explanation for it.

The Phenomenon

Aside from basic differences and similarities between vision and audition, one notes the comparative ease with which the observer perceives rotation or inversion of a visual object in space. When we attempt to find a comparable example in audition, we are unsuccessful. Although the auditory modality gives us information about distance, stimulus composition and the location of sound sources, it seems that we cannot perceptually *invert* a sound. To state the case in a different way, we are unable to invert sound emanating from space. Is this sound inversion phenomenon an impossibility due to the physical properties of sound? Is it due to the structure and function of the cochlear mechanism or can it be attributed to an inability of the CNS to mirror certain properties of sound? These are some of the possibilities which arise.

Comparative Stimulus Characteristics

The physical energy necessary for visual perception is a form of energy described as radiant energy or electromagnetic radiations. These energy particles or photons travel at approximately 186,000

miles/second. We perceive visual objects because they emit radiant energy or because radiant energy is reflected from them.

Audible, acoustic energy in space may be considered as a series of condensations and rarefactions of the atmosphere (periodic or aperiodic) that set the peripheral or mechanical portion of the ear in motion which, in turn triggers a series of energy transformations within the mechanism. We readily perceive the direction or location of a sound source binaurally but we have less definite information about the size or distance of sound objects in space. Within the human observer pitch perception may be viewed as physiological *movement* in a vertical plane, however, this is not identical with the movement of a sound source in a vertical, spatial dimension. We could extend our descriptions of auditory experiences indefinitely without accounting for the inversion phenomenon mentioned above.

Theoretical Considerations

A theory will be presented which depends on an *axis of perception* concept and is applicable to visual energy travelling in space. This axis is a line from the energy source to the receptor with the energy distributed symmetrically about this axis. This is true whether the energy source is primary, as is a light source, or secondary, as is an object from which light energy rebounds to the receptor.

The reason we can recognize an inverted visual stimulus but cannot perceive an inverted auditory stimulus may be due to the fact that the light energy reflected by a physical object has many points of reflection and therefore many axes of perception. These reflections form a pattern in a plane perpendicular to their axis of perception and as a consequence have an additional axis in that plane; an axis of symmetry normal to the axis of perception. We detect inversion only if there are differences between the energy sources. If a flawless circular surface were presented visually and rotated before a subject, he would not detect the rotation. An inverted circular disk with an uneven surface, properly illuminated, would create an axis of symmetry and rotation of this axis about the axis of perception would permit its recognition as an inverted visual object.

In the auditory realm, we can produce a complex of sounds, each with a different source; such as a central loudspeaker rimmed by a series of satellite speakers. In this situation we would detect the rotation of each individual source about the mean axis of perception even though we could not detect the rotation of each individual sound source about its own axis of perception. In audition, we perceive what

amounts to a single axis of perception and therefore are unable to experience sound inversion.

In summary, our explanation seems to account for the perception of an inverted visual object in space but only rotation and not inversion of an auditory sound. Rotation is but a form of sound localization. We can readily alter the temporal order of a tonal sequence and still lack true inversion of the auditory sound. The explanation presented here places its primary emphasis on the energy which reaches the receptor. The interested reader may find our explanation challenging and perhaps even inadequate. However, the fundamental observation that we do not perceive "upside-down" sound seems to be an original one worthy of inquiry.

Acknowledgements

The writer is indebted to Walter Whippo and Richard Griffith for several pertinent suggestions.

SHRUBBY AND HERBACEOUS FLORA OF THE BEREA COLLEGE FOREST

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The Berea College Forest is a 5,000 acre tract of land four miles east of Berea in the Big Hill region. It is within the Knob Belt of the Cincinnati arch in central Kentucky. Much of it is watershed for the three reservoirs that supply water to the Berea community. The forest is used by the college for research and demonstration of modern practices in silviculture.

The knobs of the forest contain several types of rocks and vary between 800 and 1,660 feet in elevation from their base to their peaks. The lowest rock is the Ohio black shale. Above this are layers of Cuyahoga and Logan shales; Warsaw, St. Louis, Ste. Genevieve, and Gasper limestone; Rockcastle conglomerate; and Corbin sandstone. The more resistant sandstone and conglomerate capping the knobs give them their unique shape. The soils of the knobs also reflect the nature of the rocks: basic clays are produced by shales and limestones; acidic sandy-loam is produced by the sandstone and conglomerate. The Burnt Ridge area, Millstone Ridge, Indian Fort Mountain (including East and West Pinnacles), and Bear Mountain are sandy-loam areas. Cowbell Hollow, Moonshine Hollow, Indian Fort Theater, Narrow Gap, Pigg Hollow, Gabbard House, Snake Hollow, Upper and West Lake Hollows, the forester's residence, the sawmill, Dogfoot Springs, and Grant Hollow are all underlain by shales and limestones and are therefore clay areas.

As a result of the various factors of topography, soil type, elevation, activity of man, etc., many different habitats are available to plant life. The wooded and dry sandy ridges offer one habitat; the bluffs and cliffs offer another. The moist, wooded valleys with their many streams produce other habitats. The open areas along the logging trails and around the marshy-bordered reservoirs give still other environments. Thus it can be seen that many species may be found concentrated in the relatively small confines of the college forest. Only vascular plants, with the exception of tree species, were collected. Three classes are represented in the collection: the Equisetineae, Filicineae, and Angiospermae. They include 29 orders, 75 families, 250 genera, and 448 species, varieties or forms.

The project was financed by the U. S. Forest Service through an appropriation to Berea College. Duplicate specimens were sent to the U. S. Forest Service Herbarium for verification, one specimen was deposited in the Central States Forestry Research Center herbarium, and one was deposited in the Berea College herbarium. This is only a preliminary report, as much collecting is yet to be done in the area.

DIVISION TRACHEOPHYTA
SUBDIVISION SPHENOPSIDA

EQUISETACEAE—Horsetail Family

Equisetum arvense L.—West Lake, stream bed

SUBDIVISION PTEROPSIDA
CLASS FILICINEAE

OPHIOGLOSSACEAE—Adder's-tongue Family

Botrychium dissectum Spreng. forma *obliquum* (Muhl.) Fern.—West Lake, border
B. virginianum (L.) Sw.—Upper Cowbell Hollow, drained woods

POLYPODIACEAE—Fern Family

Adiantum pedatum L.—Cowbell Hollow, drained woods
Asplenium montanum Willd.—Millstone Ridge, cliff crevices
Athyrium pycnocarpon (Spreng.) Tidestr.—Cowbell Hollow, woods
A. thelypteroides (Michx.) Desv. form a *acrostichoides* (Sw.) Gilbert—Upper Cowbell Hollow, sandy loam in woods
Camptosorus rhizophyllus (L.) Link—Upper Cowbell Hollow, cliffs
Cystopteris fragilis (L.) Bernh. var. *protusa* Weatherby—Cowbell Hollow, along stream in woods
Dryopteris hexagonoptera (Michx.) Christens.—Pigg Hollow, open, wet soil
D. marginalis (L.) A. Gray—Indian Fort Mtn., mixed woods
D. noveboracenis (L.) A. Gray—Upper Dogfoot Springs, stream in mixed woods
Onoclea sensibilis L.—Cowbell Hollow, border
Polypodium virginianum L. var. *virginianum*—Upper Cowbell Hollow, rock cliffs in mixed woods
Polystichum acrostichoides (Michx.) Schott—Upper Cowbell Hollow, mixed hardwoods
Woodsia obtusa (Spreng.) Torr.—Burnt Ridge Road, sandy woods

CLASS ANGIOSPERMAE
SUBCLASS MONOCOTYLEDONAE

TYPHACEAE—Cat-tail Family

Typha glauca Godr.—West Lake, marsh above lake

GRAMINEAE—Grass Family

Agropyron repens (L.) Beauv.—West Lake, border
Agrostis alba L.—Burnt Ridge, border
A. perennans (Walt.) Tuckerm.—Indian Fort Theater, border
Andropogon virginicus L.—West Lake, border
Brachyelytrum erectum (Schreb. Beauv.—Indian Fort Mtn., sandy hardwoods
Bromus japonicus Thunb.—Pigg Hollow, fields and borders
B. purgans L.—Indian Fort Mtn., open woodlands
B. tactorum L.—Indian Fort Theater, waste areas
Dactylis glomerata L.—Indian Fort Theater, waste area

Danthonia spicata (L.) Beauv.—Cowbell Hollow, open woods
Digitaria ishaemus (Schreb.) Muhl.—Pigg Hollow, bordering road
Elymus villosus Muhl.—Burnt Ridge, field border
E. virginicus L.—Grant House, closed woods
Glyceria striata (Lam.) Hitchc.—moist, mixed woods
Holcus lanatus L.—Indian Fort Theater, waste area in woods
Hysterix patula Moench—Indian Fort Mountain, open hardwoods
Leersia oryzoides (L.) Sw.—West Lake, Marsh
L. virginica Willd.—Cowbell Hollow, moist hardwoods
Microstegium viminium (Trin.) A. Camus—Burnt Ridge, below limestone cliffs
Muhlenbergia frondosa (Poir.) Fern.—Burnt Ridge Road, border
M. tenuiflora (Willd.) BSP.—Cowbell Hollow, mixed hardwoods
Panicum anceps Michx.—Cowbell Hollow, open oak woods
P. ashei Pearson—Pigg House, mixed woods
P. boscii Poir.—Narrow Gap Trail, open woods
P. capillare L.—Gabbard's House, road border
P. clandestinum L.—Cowbell Hollow, road border
P. communatum Schult.—Pigg House, mixed woods
P. depauperatum Muhl.—Indian Fort Theater, mixed hardwoods
P. dichotomiflorum Michx.—Cowbell Lake, marsh
P. dichotomum L.—Cowbell Lake, mixed hardwoods
P. hauchucae Ashe var. *fasciculatum* (Torr.) Hubb.—Pigg Hollow, border
P. microcarpon Muhl.—Pigg Hollow, mixed hardwoods
P. polyanthes Schult.—Upper Lake, mixed open woods
P. werneri Scribn.—Indian Fort Theater, mixed hardwoods
Paspalum laeve Michx.—Indian Fort Theater, mixed woods
Phleum pratense L.—Pigg Hollow, border of field
Poa compressa L.—Indian Fort Theater, open meadow
P. cuspidata Nutt.—Millstone Ridge, sandy woods on ridge
P. pratensis L.—Narrow Gap, border
P. sylvestris A. Gray—Snake Hollow, field
Setaria faberii Herrm.—Lower Cowbell Hollow, border
S. glauca (L.) Beauv.—Cowbell Hollow, border of marsh
Tridens flavus (L.) Hitchc.—West Lake, road and woods border

CYPERACEAE—Sedge Family

Carex artitecta Mack.—Indian Fort Mtn., open mixed hardwoods
C. blanda Dewey—Narrow Gap, border
C. complanta Torr. & Hook.—West Pinnacle, mixed hardwoods
C. digitalis Willd.—Cowbell Hollow, moist mixed hardwoods
C. frankii Kunth—Pigg House, moist open meadow
C. hirsutella Mack.—Narrow Gap, border
C. lurida Wahlenb.—Cowbell Lake, stream bank
C. pensylvanica Lam.—West Pinnacle, mixed hardwoods
C. plantaginea Lam.—Cowbell Hollow, mixed hardwoods
C. prasina Wahlenb.—Cowbell Hollow, wet woods
C. torta Bott—Cowbell Lake, stream bed
C. tribuloides Wahlenb.—West Lake, lake shore
C. vulpinoidea Michx.—Cowbell Lake, stream bank in woods
Cyperus filiculmis Vahl—Indian Fort Mtn., mixed hardwoods
Eleocharis obtusa (Willd.) Schult.—Sawmill, wet woods
Rhynchospora capitellata (Michx.) Vahl—Pigg Hollow, moist woods
Scirpus atrovirens Willd.—West Lake, lake shore
S. cyperinus (L.) Kunth—West Lake, stream border
S. lineatus Michx.—Narrow Gap, marshy ditch
S. rubricosus Fern.—Cowbell Hollow, border
S. validus Vahl—West Lake, marsh

ARACEAE—Arum Family

Arisaema atrorubens (Ait.) Blume—Cowbell Hollow, mixed hardwoods
A. triphyllum (L.) Schott—Cowbell Hollow, mixed hardwoods

COMMELINACEAE—Spiderwort Family

Commelina communis L.—Lower Cowbell Hollow, open border
Tradescantia subaspera Ker—Upper Cowbell Hollow, hardwoods slope

JUNCACEAE—Rush Family

Juncus acuminatus Michx.—West Lake, marsh
J. effusus L. var. *solutus* Fern. & Wieg.—West Lake, marsh
J. tenuis Willd.—Cowbell Lake, woods border

LILIACEAE—Lily Family

Allium tricoccum Ait.—Upper Lake Hollow, stream bank in woods
A. vineale L.—Burnt Ridge, road border
Asparagus officinalis L.—Narrow Gap, roadside border
Disporum languinosum (Michx.) Nicholson—Cowbell Hollow, mixed hardwoods
Erythronium americanum Ker—Cowbell Hollow, mixed hardwoods
Mediola virginiana L.—Burnt Ridge, mixed hardwoods
Polygonatum biflorum (Walt.) Ell.—Upper Snake Hollow, mixed hardwoods on slope
Smilacina racemosa (L.) Desf. var. *cylindrata* Fern.—Dogfoot Springs, mixed hardwoods
Smilax ecirrhata (Englem.) Wats.—Upper Cowbell Hollow, mixed hardwoods
S. rotundifolia L.—Gabbard Ridge, mixed hardwoods
Trillium erectum L. forma *albiflorum* R. Hoffm.—Cowbell Hollow, mixed hardwoods in cove
T. erectum L. (typical sp.)—Cowbell Hollow, mixed hardwoods
T. glandiflorum (Michx.) Salisb.—Dogfoot Springs, cove hardwoods
T. sessile L.—Cowbell Hollow, mixed hardwoods
Uvularia perfoliata L.—Cowbell Hollow, hardwoods slope

DIOSCOREACEAE—Wild Yam Family

Dioscorea quaternata (Walt.) J. F. Gmel.—Upper Lake Hollow, woods border

AMARYLLIDACEAE—Amaryllis Family

Hypoxis hirsuta (L.) Cov.—Upper Snake Hollow, open woods trail

IRIDACEAE—Iris Family

Iris cristata Ait.—Cowbell Hollow, open hardwoods
Sisyrinchium graminoides Bickn.—Cowbell Hollow, open woods

ORCHIDACEAE—Orchid Family

Cypripedium acaule Ait.—Burnt Ridge, hilltop mixed woods
C. calceulus L. var. *pubescens* (Willd.) Correll—Upper Cowbell Hollow, covers in mixed hardwoods
Goodyera pubescens (Willd.) R. Br.—Cowbell Hollow, woods slope
Habenaria peramoena A. Gray—Cowbell Hollow, meadow
Orchis spectabilis L.—Upper Cowbell Hollow, mixed hardwoods
Spiranthes cernua (L.) L. C. Rich.—West Lake, border
S. cernua (L.) L. C. Rich. var. *odorata* (Nutt.) Correll—as above
S. vernalis Engeln. & Gray—Grant House, meadow
Tipularia discolor (Pursh) Nutt.—Upper Lake Hollow, mixed woods

SUBCLASS DICOTYLEDONAE

SALICACEAE—Willow Family

Salix interior Rowlee—Cowbell Hollow, stream bed
S. *sp.*—Snake Hollow, open branch bank

CORYLACEAE—Hazel Family

Corylus americana Walt.—Snake Hollow, open stream bank

URTICACEAE—Nettle Family

Boehmeria cylindrica (L.) Sw.—Upper Lake, moist meadow
Laportia canadensis (L.) Wedd.—Upper Cowbell Hollow, moist woods
Pilea pumila (L.) A. Gray—Upper Cowbell Hollow, moist hardwoods

ARISTOLOCHIACEAE—Birthwort Family

Asarum canadense L.—Grant House, steep wooded slope

POLYGONACEAE—Buckwheat family

Polygonum aviculare L. var. *aviculare*—Upper Lake, marsh
P. hydropiper L.—Indian Fort Mountain, mixed hardwoods
P. persicaria L.—Cowbell Hollow, thicket
P. punctatum Ell.—Lower Cowbell Hollow, moist woods border
P. punctatum Ell. var. *leptostachyum* (Meisn.) Small—West Lake, marsh
P. sagittatum L.—Upper Lake, wet meadow
P. scandens L.—Pigg Hollow, border
P. virginianum L.—Cowbell Hollow, lake shore
Rumex acetosella L.—Lower Cowbell Hollow, old pasture
R. pulcher L.—Pigg Hollow, field and woods border

CHENOPODIACEAE—Goosefoot Family

Chenopodium album—L. Pigg Hollow, border of field

PHYTOLACCACEAE—Polkweed Family

Phytolacca americana L.—Cowbell Lake, roadside thicket

PORTULACACEAE—Purslane Family

Claytonia virginica L.—Snake Hollow, mixed hardwoods

CARYOPHYLLACEAE—Pink Family

Arenaria patula Michx.—Indian Fort Mtn., soil on limestone rock
Cerastium nutans Raf.—Cowbell Hollow, woods border
Paronychia canadensis (L.) Wood—Indian Fort Mtn., open woods
P. fastigiata (Raf.) Fern. var. *paleacea* Fern.—Lower Cowbell Hollow, border
Silene stellata (L.) Ait. f.—Upper Lake Hollow, open woods
S. *virginica* L.—Cowbell Hollow, hardwoods below sandstone cliffs
Stellaria media (L.) Cyrillo—Upper Lake, meadow
S. *pubera* Michx.—Cowbell Hollow, mixed hardwoods

RANUNCULACEAE—Crowfoot Family

Actaea pachypoda Ell.—Upper Cowbell Hollow, mixed hardwoods
Anemone virginiana L.—Lower Cowbell Hollow, thicket border
Anemonella thalictroides (L.) Spash.—Cowbell Hollow, woods
Aquilegia canadensis L.—Cowbell Hollow, limestone crevices in mixed woods
Cimicifuga racemosa (L.) Nutt.—West Pinnacle, mixed hardwoods
Delphinium tricorne Michx.—Cowbell Hollow, mixed hardwoods

Hepatica acutiloba DC.—Grant House, wooded slope
Hydrastis canadensis L.—Moonshine Hollow, hardwoods border, moist soil
Ranunculus fascicularis Muhl.—Cowbell Hollow, mixed hardwoods
R. recurvatus Poir.—Cowbell Hollow, mixed hardwoods slope
Thalictrum dioicum L.—Moonshine Hollow, steep wooded slope
T. polygamum Muhl.—Lower Cowbell Hollow, thicket

BERBERIDACEAE—Barberry Family

Caulophyllum thalictroides (L.) Michx.—Grant House, wooded slope
Jeffersonia diphylla (L.) Pers.—Moonshine Hollow, mixed woods
Podophyllum peltatum L.—Cowbell Hollow, mixed hardwoods

ANNONACEAE—Custard-apple Family

Asimina triloba (L.) Dunal.—Moonshine Hollow, mixed woods

LAURELACEAE—Laurel Family

Lindera benzoin (L.) Blume—Cowbell Hollow, mixed hardwoods

PAPAVERACEAE—Poppy Family

Dicentra canadensis (Goldie) Walp.—Grant Hollow, wooded slope
D. cucullaria (L.) Beruh.—Grant Hollow, wooded slope below limestone cliffs
Sanguinaria canadensis L.—Cowbell Hollow, mixed hardwoods
Stylophorum diphyllum (Michx.) Nutt.—Snake Hollow, hardwoods

CRUCIFERAE—Mustard Family

Alliaria offinalis Andrz.—Bear Mountain, open woods, old homestead
Arabis laevigata (Muhl.) Poir.—Grant House Hollow, wooded slope
Barbarea vulgaris R. Br.—Cowbell Hollow, field and woods border
Cardamine parviflora L.—West Lake, open grassy hillside
C. parviflora var. *arenicola* (Britt.) O. E. Schulz—West Pinnacle, open hardwoods
C. rotundifolia Michx.—Cowbell Hollow, wet woods border
Dentaria diphylla Michx.—Upper Lake, woods border
D. heterophylla Nutt.—Moonshine Hollow, cove hardwoods
D. lacinata Muhl.—Cowbell Hollow, mixed hardwoods
Draba verna L.—Upper Lake, dam in open
Lepidium campestre L.—Cowbell Hollow, mixed woods
L. virginicum L.—Indian Fort Theater, mixed woods
Thalaspe perfoliatum L.—Indian Fort Theater, woods border

CRASSULACEAE—Orpine Family

Sedum pulchellum Michx.—Indian Fort Mtn., shaded cliffs
S. ternatum Michx.—Cowbell Hollow, shaded soil covered boulders

SAXIFRAGACEAE—Saxifrage Family

Heuchera americana L.—Cowbell Hollow, open hardwoods
H. parviflora Bartl. var. *rugeliii* (Schuttlw.) Rosend, Butt. & Lak.—Upper Cowbell Hollow, crevices of sandstone
H. villosa Michx.—Indian Fort Theater, cliff base in woods
Hydrangea arborescens L.—Indian Fort Trail, open hardwoods
Mitella diphylla L.—Cowbell Hollow, woods border on bank
Penthorum sedoides L.—Cowbell Hollow, stream bank in woods
Tiarella cordifolia L.—Cowbell Hollow, slightly open woods

HAMAMELIDACEAE—Witch-hazel Family

Hamamelis virginiana L.—Moonshine Hollow, mixed hardwoods

ROSACEAE—Rose Family

Agrimonia parviflora Ait.—Grant House, meadow
A. rostellata Wallr.—Indian Fort Trail, open hardwoods
Amelanchier arborea (Michx. f.) Fern.—Lower Cowbell Hollow, woods
Aruncus dioicus (Walt.) Fern.—Cowbell Hollow, hardwoods
Fragaria virginiana Duchesne—Cowbell Hollow, border of field
Geum canadense Jacq.—Cowbell Hollow, thicket
Gillenia stipulata (Muhl.) Baill.—Indian Fort Theater, open woods
Potentilla canadensis L.—Cowbell Hollow, border of road
P. norvegica L.—Burnt Ridge, old pasture
P. simplex Michx.—Cowbell Hollow, woods border
Ribes cynosbati L.—West Lake area, limestone cliffs in woods
Rosa carolina L.—Indian Fort Theater, hardwoods border
Rubus sp.—Upper Lake, woods border
Rubus flagellaris Willd.—Upper Lake, woods border

LEGUMINOSAE—Pulse Family

Amphicarpaea bracteata (L.) Fern. var. *comosa* (L.) Fern.—Cowbell Lake, waste area
Cassia fasiculata Michx.—Lower Cowbell Hollow, border
C. hebecarpa Fern.—Lower Cowbell Hollow, thicket
C. nictitans L.—Lower Cowbell Hollow, field border
Desmodium glutinosum (Muhl.) Wood—Cowbell Hollow, open woods
D. marilandicum (L.) DC.—West Lake, border
D. nudiflorum (L.) DC.—Upper Cowbell Hollow, mixed hardwoods
D. paniculatum (L.) DC.—Pigg Hollow, woods border
D. perplexum Schub.—Cowbell Lake, border
D. rigidum (Ell.) DC.—West Lake, open border
Lespedeza procumbens L.—Indian Fort Theater, open woods
L. repens (L.) Bart.—Indian Fort Theater, open woods
Medicago lupulina L.—Indian Fort Theater, meadow
Melilotus alba Desr.—Lower Cowbell Hollow
M. officinalis (L.) Lam.—Upper Lake, border of road
Strophlostyles helvola (L.) Ell.—Cowbell Hollow, border
Stylosanthes biflora (L.) BSP.—Indian Fort Theater, open woods
Tephrosia virginiana (L.) Pers.—Burnt Ridge, open hardwoods
Trifolium pratense L.—Lower Cowbell Hollow, border old field
T. procumbens L.—Grant House, meadow
T. repens L.—Lower Cowbell Hollow, border
Vicia caroliniana Walt.—Cowbell Hollow, woods border

LINACEAE—Flax Family

Linum medium (Planch.) Britt. var. *texanum* (Planch.) Fern.—Indian Fort Theater, mixed open woods
L. striatum Walt.—Sawmill, border

OLALIDACEAE—Wood-Sorrel Family

Oxalis europaea Jord.—Lower Cowbell Hollow, border
O. grandis Small—Cowbell Hollow, mixed hardwoods
O. violacea L.—Cowbell Hollow, mixed hardwoods

GERANIACEAE—Geranium Family

Geranium carolinianum L.—Narrow Gap, road border
G. columbinum L.—Grant House, grassy meadow
G. maculatum L.—Cowbell Hollow, border of woods

POLYGALACEAE—Milkwort Family

Polygala curtissii A. Gray—Burnt Ridge Road, border
P. sanguinea L.—West Lake, meadow
P. verticillata L. var. *ambigua* (Nutt.) Wood—Indian Fort Theater, open woods

EUPHORBIACEAE—Spurge Family

Aclypa virginica L.—Lower Cowbell Hollow, border
Euphorbia maculata L.—Pigg Hollow, woods border

ANACARDIACEAE—Cashew Family

Rhus copallina L. var. *latifolia* Engler—Burnt Ridge, open woods
R. glabra L.—Burnt Ridge Road, border
R. radicans L. var. *vulgaris* (Michx.) DC. forma *negundo* (Greene) Fern.—Narrow Gap, woods border

CELASTRACEAE—Staff-tree Family

Euonymus atropurpureus Jacq.—Indian Fort Mtn., open woods

STAPHYLEACEAE—Bladdernut Family

Staphalea trifolia L.—Moonshine Hollow, cove hardwoods

BALSAMINACEAE—Touch-me-not Family

Impatiens capensis Meerb.—Upper Lake, stream border
I. pallida Nutt.—Pigg Hollow, wooded stream bank

RHAMNACEAE—Buckthorn Family

Ceanothus americanus L.—Indian Fort Mtn., open sandy woods
Rhamnus caroliniana Walt.—Burnt Ridge Road, mixed woods

GUTIFERAE—St. John's-wort Family

Ascyrum hypercoides L. var. *multicaule* (Michx.) Fern.—Burnt Ridge, open woods
Hypericum drummondii (Grev. & Hook) T. & G.—Indian Fort Theater, open woods
H. gentianoides (L.) BSP.—Lower Cowbell Hollow, woods border
H. multilum L.—Lower Cowbell Hollow, border
H. punctatum Lam.—Cowbell Lake, open hardwoods

CESTACEAE—Rockrose Family

Lechea minor L.—Sawmill, mixed woods

VIOLACEAE—Violet Family

Hybanthus concolor (T. F. Forst) Spreng.—Upper Lake Hollow, woods
Viola canadensis L.—Cowbell Hollow, mixed hardwoods
V. hirsutula Brainerd—Cowbell Hollow, mixed hardwoods
V. macloskeyi F. E. Lloyd ssp. *palens* (Bank.) M.S. Baker—Grant House Hollow, hardwoods
V. pedata L. var. *lineariloba* DC.—Indian Fort Mtn.
V. pedata L. var. *pedata*—Indian Fort Mtn., pine woods slope
V. pensylvanica Michx.—Cowbell Hollow, mixed hardwoods
V. rostrata Pursh—Cowbell Hollow, woods border
V. striata Ait.—Snake Hollow, woods border
V. sororia Willd.—Indian Fort Mtn., mixed hardwoods
V. triloba Schwein.—Cowbell Hollow, woods border

PASSIFLORACEAE—Passion-flower Family

Passiflora lutea L. var. *glabrifolia* Fern.—Cowbell Hollow, open woods

LYTHRACEAE—Loosestrife Family

Cuphea petiolata (L.) Koehne—Upper Lake, road and woods border

MELASTOMATACEAE—Melastoma Family

Rhexia virginica L.—Cowbell Lake, meadow

ONAGRACEAE—Evening-Primrose Family

Ciraea quadrisculcata (Maxim.) Franch. & Sav. var. *canadensis* (L). Hara.—Cowbell Hollow, open hardwoods
Ludwigia alternifolia L.—Cowbell Hollow, open woods
Oenothera biennis L.—Grant House, old meadow
O. biennis L. var. *nutans* (Atkins. & Bartl.) Wieg.—Cowbell Lake, waste area
O. tetragonia Roth.—Cowbell Lake, open border

UMBELLIFERAE—Parsley Family

Chaerophyllum tainturieri Hook.—Indian Fort Theater, woods border
Cryptotaenia canadensis (L.) DC.—Cowbell Hollow, open hardwoods
Daucus carota L.—Lower Cowbell Hollow, border
Erigenia bulbosa (Michx.) Nutt.—Grant House, mixed hardwoods
Osmorhiza claytoni (Michx.) C.B. Clarke—Dogfoot Springs, woods
Sanicula canacensis L.—Indian Fort Trail, mixed hardwoods
S. gregaria Bickn.—Indian Fort Mtn., mixed hardwoods
Taenidia integerrima (L.) Drude—Bear Mountain, hardwoods
Thaspium barbinode (Michx.) Nutt.—Cowbell Hollow, woods border
Zizia aurea (L.) W. D. J. Koch—Cowbell Lake, border

CORNACEAE—Dogwood Family

Cornus amomum Mill.—Indian Fort Theater, marsh

PYROLACEAE—Wintergreen Family

Chimaphila maculata (L.) Pursh—Upper Cowbell Hollow, sandy woods
Monotropa hypopithys L.—Pigg House, mixed hardwoods
M. uniflora L.—Pigg House, hardwoods

ERICACEAE—Heath Family

Epigaea repens L.—Millstone Ridge, sandy woods
Gaultheria procumbens L.—Upper Dogfoot Springs, sandy woods
Kalmia latifolia L.—East Pinnacle, oak woods sandy soil
Vaccinium corymbosum L.—Dogfoot Springs, sandstone woods
V. stamineum L. var. *neglectum* (Small) Deam—Indian Fort Theater, mixed woods, clay loam
V. vacillans Torr.—Millstone Ridge, sandstone hardwoods

PRIMULACEAE—Primrose Family

Anagallis arvensis L.—Lower Cowbell Hollow, woods border
Lysimachia lanceolata Walt.—West Lake, open woods
L. quadrifolia L.—Indian Fort Theater, mixed woods
Samolus parviflorus Raf.—Cowbell Lake, stream bank

GENTIANACEAE—Gentian Family

Frasera (Swertia) carolinensis Walt.—Scaffold Cane Ridge, woods
Obolaria virginica L.—Burnt Ridge, hardwoods on sandstone
Sabatia angularis (L.) Pursh—Cowbell Hollow, moist meadow

APOCYNACEAE—Dogbane Family

Apocynum canabium L.—Pigg Hollow, woods border

ASCLEPIADACEAE—Milkweed Family

Asclepias incarnata L.—Cowbell Hollow, open swamp
A. quadrifolia Jacq.—Pigg Hollow, hardwoods on slope

Asclepias syriaca L.—Lower Cowbell Hollow, thicket border
A. tuberosa L.—Burnt Ridge, old pasture
Gonolobus obliquus (Jacq.) Schultes—Cowbell Lake, border

CONVOLVULACEAE—Convolvulus Family

Cuscuta gronovii Willd.—Pigg Hollow, woods border
C. pentagona Engelm.—Cowbell Hollow, logging trail
Ipomoea pandurata (L.) G. F.W. Mey.—Upper Lake, field border

POLEMONIACEAE—Polemonium Family

Phlox carolina var. *triflora* (Michx.) Wherry—West Lake, open woods
P. divaricata L.—Snake Hollow, mixed hardwoods
P. maculata L.—Cowbell Hollow, open woods
Polemonium reptans L.—Cowbell Hollow, mixed hardwoods

HYDROPHYLLACEAE—Waterleaf Family

Hydrophyllum appendiculatum Michx.—Upper Snake Hollow, moist woods

BORAGINACEAE—Borage Family

Cynoglossum boreale Fern.—Upper Lake Hollow, hardwoods on slope
Lithospermum arvense L.—Indian Fort Theater, road border
L. canescens (Michx.) Lehm.—Indian Fort Mtn., mixed woods ridge
Mertensia virginica (L.) Pers.—Grant House Hollow, hardwoods
Mysotis verna Nutt.—Snake Hollow, hardwoods

VERBENACEAE—Vervain Family

Lippia lanceolata Michx.—Grant House, meadow
Verbena urticifolia L.—Cowbell Lake, open hardwoods

LABIATAE—Mint Family

Collinsonia canadensis L.—Indian Fort Theater, hardwoods
Cunila origanoides (L.) Britt.—Indian Fort Theater, open woods
Glecoma hederacea L. var. *micrantha* Morcand—Bear Mtn., open woods
Hedeoma pulegiodes (L.) Pers.—Lower Cowbell Hollow, border woods
Lamium amplexicaule L.—Indian Fort Theater, woods border
L. purpureum L.—Indian Fort Theater, open woods
Lycopus virginicus L.—Cowbell Lake, shore
Monarda fistulosa L.—Upper Cowbell Hollow, hardwoods border
Physostegia virginiana (L.) Benth.—Indian Fort Mtn., oak woods
Prunella vulgaris L.—Burnt Ridge, woods border
Pycanthemum flexuosum (Walt.) BSP.—Pigg Hollow, woods border
P. tenuifolium Schrad.—West Lake, lake shore
Salvia lyrata L.—Narrow Gap, road border
Scutellaria lateriflora L.—Upper Lake Hollow, stream bed in woods
S. incana Biehler—Indian Fort Mtn., mixed woods
S. nervosa Pursh var. *nervosa*—Snake Hollow, hardwoods
Stachys riddellii House—Cowbell Hollow, open hardwoods

SOLANACEAE—Nightshade Family

Pthysolis heterophylla Nees—Upper Lake, meadow
Solanum carolinense L.—West Lake, pasture

SCROPHULARIACEAE—Figwort Family

Collinsia verna Nutt.—Upper Snake Hollow, open hardwoods
Gerardia grandiflora Benth.—Upper Lake Hollow, open hardwoods
G. laevigata Raf.—Cowbell Lake, lake shore
G. tenuifolia Vahl—Pigg Hollow, mixed woods
Linaria vulgaris Hill—Burnt Ridge Road, road border

Lindernia anagallidea (Michx.) Pers.—Cowbell Lake, disturbed soil
Mimulus alatus Ait.—Indian Fort Theater, mixed woods, moist soil
Pedicularis canadensis L.—Cowbell Hollow, woods border
Penstemon laevigatus Ait.—Upper Lake, woods border
Veronica officinalis L.—Cowbell Lake, hardwoods

OROBANCHACEAE—Broom-rape Family

Conopholis americana (L.) Wallr.—Upper Cowbell Hollow, oak woods

ACANTHACEAE—Acanthus Family

Ruellia caroliniensis (Walt.) Steud.—Cowbell Lake, open woods

PHRYMACEAE—Lopseed Family

Phryma leptostachya L.—Upper Cowbell Hollow, mixed hardwoods

PLANTAGINACEAE—Plantain Family

Plantago aristata Michx.—Pigg Hollow, field-woods border
P. lanceolata L.—Lower Cowbell Hollow, border

RUBIACEAE—Madder Family

Diodia teres Walt.—Lower Cowbell Hollow, field border
Galium circaezans Michx.—Indian Fort Mtn., oak forest
G. pilosum Ait. var. *puncticulosum* (Michx.) T. & G.—Grant House, grassy meadow
G. triflorum Michx.—Indian Fort Mtn., oak woods on sandstone
Houstonia caerulea L.—Cowbell Lake, open hardwoods
H. canadensis Willd.—Upper Snake Hollow, hardwoods
H. purpurea L.—Indian Fort Theater, hardwoods

CAPRIFOLIACEAE—Honeysuckle Family

Sambucus canadensis L.—Cowbell Hollow, thicket border
Triosteum angustifolium L.—Upper Lake Hollow, hardwoods

CAMPANULACEAE—Bluebell Family

Campanula americana L.—Cowbell Lake, oak woods border
Lobelia inflata L.—Pigg Hollow, open woods
L. puberula Michx.—Pigg Hollow, mixed woods
L. siphilitica L.—Pigg Hollow, moist woods
L. spicata Lam. var. *leptostachya* (A.DC.) Mackenz. & Bush.—West Lake, open oak woods

COMPOSITAE—Composite Family

Achillea millefolium L.—Lower Cowbell Hollow, pasture
Actinomeris alternifolia (L.) DC.—West Lake, road and woods border
Ambrosia artemisiifolia L.—Pigg Hollow, field-woods border
Antennaria plataginifolia (L.) Hook.—Cowbell Hollow, hardwoods
A. solitaria Rybd.—Upper Lake, woods border
Anthemis cotula L.—Sawmill, field
Aster azureus Lindl.—Cowbell Hollow, hardwoods
A. infirmus Michx.—Pigg Hollow, mixed woods
A. lateriflorus (L.) Britt.—Grant House, pasture border
A. linariifolius L.—Burnt Ridge Road, woods border
A. lowrieanus Porter—Grant House, hardwoods
A. macrophyllus L. var. *macrophyllus*—Cowbell Hollow, hardwoods
A. novae-angliae L.—Cowbell Lake, border
A. ontarionis Wieg.—West Lake, woods border
A. pilosus Willd. var. *demotus* Blake—West Lake, border
A. pilosus Willd. var. *pilosus*—Grant House, woods border
A. polyanthus Schult.—Burnt Ridge Road, border

Aster prenanthoides Muhl.—Cowbell Hollow, border
A. surculosus Michx.—Burnt Ridge Road, border
A. vimineus Lam.—West Lake, border
Bidens bipinnata L.—Indian Fort Theater, border
B. discoidea (T. & G.) Britt.—Indian Fort Theater, open woods
B. polylepis Blake—Burnt Ridge road, road border
Chrysanthemum leucanthemum L. var. *pinnatifidum* Leoq. & Lamotte—Cowbell Hollow, old pasture
Chrysopsis mariana (L.) Ell.—Indian Fort Theater, woods border
Cichorium intybus L.—Indian Fort Theater, edge highway
Cirsium discolor (Muhl.) Spreng.—Sawmill, border
Coreopsis auriculata L.—Indian Fort Theater, hardwoods
C. major Walt. var. *stellata* (Nutt.) Robins.—West Lake, open oak woods
C. tripteris L.—Cowbell Lake, open hardwoods
Echinacea purpurea (L.) Moench—West Pinnacle, open hardwoods
Elephantopus carolinianus Raeuschel—Upper Lake, border
Erechtites hieracifolia (L.) Raf.—Indian Fort Theater, border
Erigeron annuus (L.) Pers.—West Lake, road border
E. canadensis L.—Pigg Hollow, old field border
E. philadelphicus L.—Upper Snake Hollow, open hardwoods
E. pulchellus Michx.—Indian Fort Mountain, hardwoods
E. strigosus Muhl.—West Lake, pasture
Eupatorium coelestinum L.—West Lake, woods border
E. fistulosum Barrett—Pigg Hollow, field border
E. perfoliatum L.—West Lake, woods border
E. rugosum Houtt.—Cowbell Hollow, open woods
E. serotinum Michx.—Cowbell Lake, hardwoods
E. sessilifolium L.—Indian Fort Theater, hardwoods
Gnaphalium obtusifolium L. var. *obtusifolium*—Burnt Ridge Road, border
G. purpureum L.—West Lake, open meodow
Helianthus angustifolius L.—West Lake, woods border
H. decapetalus L.—Cowbell Hollow, open hardwoods
H. divaricatus L.—Indian Fort Trail, open woods
H. hirsutus Raf. var. *hirsutus*—Cowbell Hollow, open woods
H. strumosus L.—Cowbell Lake, open hardwoods
Hieracium gronovii L.—Indian Fort Theater, mixed woods
H. paniculatum L.—West Lake, open oak woods
Krigia biflora (Walt.) Blake—Cowbell Hollow, woods border
Lactuca canadensis L. var. *longifolia* (Michx.) Farw.—Burnt Ridge, border
L. floridana (L.) Guertn. var. *villosa* (Jacq.) Cronq.—Upper Lake, woods border
L. scariola L.—Lower Cowbell Hollow, waste area
Polymnia canadensis L.—Indian Fort Mtn., mixed woods
P. uvedalia L.—Cowbell Hollow, mixed woods
Prenanthes altissima L. var. *altissima*—Lower Cowbell Hollow, woods border
Pyrrhopappus carolinianus (Walt.) DC.—Grant House, meadow
Rudbeckia fulgida Ait. var. *umbrosa* (Boynt. & Beadle) Cronq.—Cowbell Hollow, border
R. hirta L.—Burnt Ridge, border of field
Senecio aureus L.—Indian Fort Theater, mixed woods
S. obvatus Muhl.—Grant House Hollow, hardwoods
S. smallii Britt.—Indian Fort Theater, oak woods
Sericocarpus asteroides (L.) BSP.—Burnt Ridge, open hardwoods
S. linifolius (L.) BSP.—Burnt Ridge, open woods
Silphium trifoliatum L.—Pigg Hollow, woods border
Solidago bicolor L.—Cowbell Hollow, border
S. caesia L.—Cowbell Hollow, hardwoods
S. erecta Pursh—open woods

Solidago flexicaulis L.—Upper Cowbell Hollow, hardwoods
S. *juncea* Ait.—Indian Fort Mountain, open woods
S. *nemoralis* Ait.—Indian Fort Theater, open woods
S. *sphacelata* Raf.—Cowbell Hollow, open hardwoods
S. *rugosa* Ait.—Cowbell Lake, border
Taraxacum officinale Weber—Snake Hollow, grassy meadow
Veronia altissima Nutt.—Cowbell Hollow, border
Xanthium strumarium L. var. *glabratum* (DC.) Cronq.—Sawmill, road border

ACADEMY AFFAIRS

1962 Fall Meeting

The forty-eighth annual business meeting of the Kentucky Academy of Science was held on the campus of Eastern Kentucky State College on November 10, 1962 with C. Whittle presiding.

The minutes of the previous meeting were read and approved.

The treasurer's report, previously audited by R. Wiseman, R. Boyer, and R. Barbour, was presented by R. Chapman. The report was approved by the Academy.

T. Hutto reported on the Junior Academy activities of the previous year. A science fair was held on May 11 and 12, 1962 in Lexington with thirty clubs represented by about 200 students. He indicated the need for financial support of the Junior Academy and pointed out that he has applied for a National Science Foundation grant for travel expenses for students and sponsors attending Junior Academy meetings as well as secretarial and miscellaneous expenses on his part. At the present time the Phillip Morris Company is the only substantial financial supporter of the Junior Academy activities. It was moved and seconded that the report be accepted. The motion carried.

T. Hutto requested changes in the Junior Academy constitution. The main changes included statements regarding duties of the officers of the Junior Academy and duties of the three Counselors appointed by the Senior Academy. The duties of the latter were designated as director, membership chairman, and editor of the Junior Science Bulletin. After some discussion regarding the lack of time to study the proposed changes the motion to accept the changes was seconded and carried.

H. LaFuze reported on an item previously discussed by the executive committee. He has been active in the Westinghouse Science Talent search. State level awards are given by many State Academies and H. LaFuze recommended that the Kentucky Academy finance the prizes (subscriptions to Science or Scientific American) and other possible expenses up to a total of $35 for Kentucky winners. The state level winners are judged on test scores and on their projects. It was moved and seconded that the Academy finance awards and expenses up to $35. The motion carried. C. Whittle pointed out that the executive committee had discussed having the Junior Academy Counselors handle the Kentucky Talent search but decided that it probably would be better ho have the director of the latter independent of the Junior Academy.

In reporting for the research grant committee (W. Sumpter and H. LaFuze) W. Sumpter recommended that Ruth Browne be granted $50 for a coral and stratigraphy study and that Thomas Kargl be granted $50 for a chromatographic separation of 2,4-dinitrophenylhydrazones study. It was moved and seconded that these awards be made. The motion carried.

A list of new members to be approved by the Academy included: Vincent Brescia, Paul Christian, Armin Clark, Marylin Cole, Joseph Collins, Charles Ferguson, Claude Gentry, Z. S. Gierlach, Corson Hirschfeld, Henry H. Howell, Sanford Jones, Ray Jordan, and Sister Augustine Mattingly. It was moved and seconded that these be approved. The motion carried.

The nominating committee presented the following nominees:

President elect: Richard Chapman

Vice President: Dwight Lindsay

Secretary: Gerrit Levey

Treasurer: J. H. B. Garner

A. A. A. S. Representative: Mary Wharton

Board of Directors: Herbert Shadowen and Otis Wolfe

It was moved and seconded that a unanimous vote be cast for all the nominees. The motion carried.

R. Chapman spoke briefly for L. Dawson (president for 1962-1963 but unable to attend this meeting) regarding activities for the coming year. He presented an invitation to hold the fall meeting of 1963 at the University of Kentucky. He also indicated an interest in beginning a Visiting Scientists program for secondary schools and science clubs. It was moved and seconded that L. Dawson receive wholehearted support of the Academy on the latter. The motion carried.

The meeting adjourned at 9:20 a.m.

At an executive committee meeting later in the morning it was agreed that the fall meeting of 1963 be held at the University of Kentucky.

Sectional Officers For 1962-1963

Chemistry: Chm. Thomas Kargl, Ursuline College, Louisville, Ky.
Sec. Ellis Brown, Univ. of Ky., Lexington, Ky.

Geology: Chm. James E. Conkin, Univ. of Louisville
Sec. John C. Philley, Morehead State College

Botany: Chm. Carl E. Hendrickson, Univ. of Ky.
Sec. Robert Larance, Eastern Ky. State College

Zoology: Chm. Roger W. Barbour, Univ. of Ky.
Sec. J. G. Rodriguez, Univ. of Ky.

Physics: Chm. Richard Hanau., Univ. of Ky.
Sec. Otis K. Wolfe, Centre College

Microbiology: Chm. Emil Kotcher, Univ. of Louisville
Sec. Lucia Anderson, Western Ky. State College

Psychology: Chm. Joan Lee, Univ. of Ky.
Sec. Mary Ellen Curtin, Univ. of Ky.

Report of the Treasurer for the year 1961-62

Balance in checking account, Second National Bank, Lexington, Kentucky, 10-1-61		$ 665.04
Income October 1, 1961-October 1, 1962		
Regular membership dues	$ 901.50	
Sustaining membership dues	250.00	
Industrial membership dues	500.00	
A. A. A. S. research grant	100.00	
Subscriptions, Transactions of the K. A. S.	53.50	
Sale of reprints	151.48	
University of Louisville, 200 copies of Transactions	200.00	
Sale of advertising	50.00	
Total income	$2,206.48	$2,871.52
Expenditures October 1, 1961-October 1, 1962		
Appropriations to Kentucky Research Foundation for publication of Volumes 22:3-5 and 23:1-2 of Transactions of the Kentucky Academy of Science	$1,000.00	
Mailing Transactions of K. A. S.	31.50	
Secretary's expenses—notices, postage, etc.	111.31	
Treasurer's expenses—notices, postage	17.17	
Fall meeting, 1961—speaker, phone calls	77.85	
Kentucky Junior Academy of Science	1,006.00	
A. A. A. S. research grant	100.00	
Thomas Hunt Morgan Fund	35.00	
Dues to the Academy Conference	6.40	
Total expenditures	$2,385.23	$ 486.29
Balance in checking account on October 1, 1962		$ 486.29
Balance in account with Kentucky Research Foundation for publication of the Transactions of K. A. S. on October 1, 1962		$ 452.08
Balance in Savings account, Lexington Federal Savings and Loan Assn. 10-1-61		$ 629.78
Interest October 1, 1961-October 1, 1962		25.45
Balance in savings accounton October 1, 1962		$ 655.23
Balance in Thomas Hunt Morgan Fund in First Federal Savings and Loan Assn.		$ 35.46

Respectfully submitted,
Richard A. Chapman, Treasurer

Sectional Meetings

BACTERIOLOGY AND MEDICAL TECHNOLOGY

Margaret Hotchkiss, Chairman

Emil Kotcher, Secretary

1. The effect of products of heterologous microorganisms on the *in vitro* migration of leukocytes of tuberculous guinea pigs as determined by a slide culture technique.
   E. H. Gerlach and M. Scherago*, Department of Microbiology, University of Kentucky, Lexington, Kentucky.
2. The effect of products of heterologous microorganisms on the *in vitro* migration of leukocytes of tuberculous guinea pigs as measured by a capillary tube technique.
   C. Thornsberry* and M. Scherago, Department of Microbiology, University of Kentucky, Lexington, Kentucky.
3. Fluorescent antibody detection of the gonococcus.
   James A. Ellis, Louisville-Jefferson County Health Department, Louisville, Kentucky.
4. Properties of staphylococcal coagulase in relationship to the hydrolysis of peptides.
   Marvin Murray, Gail Bosley, and Carl Rutledge, Department of Pathology, University of Louisville, Louisville, Kentucky
5. The effect of tuberculin on the in vitro migration of leukocytes from guinea pigs sensitized with heat killed *Mycobacterium tuberculosis.*
   R. W. Johnson* and M. Scherago, Department of Microbiology, University of Kentucky, Lexington, Kentucky.
6. The correction of astigmatism in the electron microscope.
   O. F. Edwards, Department of Microbiology, University of Kentucky, Lexington, Kentucky.
7. *Pseudomonas* as a hospital pathogen.
   William H. Kelly, Jewish Hospital, Louisville, Kentucky.
8. Detection and isolation of the inclusion conjunctivitis virus.
   Emil Kotcher*, Kenneth Keller, Carolyn A. Frick and Doris W. Bottorff, Department of Microbiology, University of Louisville, Louisville, Kentucky.
9. The effect of uric acid upon the weight gains and the intestinal flora of chicks.
   Larry N. Bare*, and Ralph F. Wiseman, Department of Microbiology, University of Kentucky, Lexington, Kentucky.
10. The effect of uric acid upon the excretion of riboflavin in the rat.
    Paul J. Armstrong, Jr.* and Ralph F. Wiseman, Department of Microbiology, University of Kentucky, Lexington, Kentucky.
11. Physiological tests to differentiate cultures of *Streptomyces* and *Nocardia.*
    James D. Moore* and M. Hotchkiss, Department of Microbiology, University of Kentucky, Lexington, Kentucky.
12. A simple method for the conversion of diphasic fungi to the yeast phase.
    E. H. Gerlach, Department of Microbiology, University of Kentucky, Lexington, Kentucky.

ZOOLOGY SECTION

C. B. Hamann, Chairman

Allie Whitt, Secretary

1. Studies in mass rearing *Macrocheles muscadeomesticae* (*Acarina*: *Macrochelidae*) a predator of the house fly egg, by J. G. Rodriguez, Claude F. Wade, and Charles N. Wells.
2. Development of a chemically defined diet for a plant-feeding mite *Tetranychus telarius* (*Acarina*: *Tetranychidae*) by Ping Ie Sun, Thomas N. Seay, and J. G. Rodriguez.
3. Environmental Fluctuations in the Aquatic Habitat of Mammoth Cave by Robert A. Kuehne. (10 minutes)
4. A preliminary report of *Microtus* activity as influenced by climactic factors by Roger W. Barbour. (10 minutes)
5. Photographic survey of the fauna of Mammoth Cave by Thomas C. Barr, Jr. (10 minutes)
6. Studies on the reproductive potential of *Drosophila affinis* by Marvin J. Burdine and J. M. Carpenter. (10 minutes)
7. Studies on the bat *Myotis sodalis* in Carter Caves State Park, by Wayne H. Davis. (10 minutes)
8. Some endoparasites found in King snakes by M. W. Denner. (10 minutes)
9. Some viability determinations on *Trichinella spiralis* from putrescent meat in garbage by J. M. Edney and S. C. Johnson (10 minutes)
10. The effect of the cotton rat (*Sigmodon hispidus*) on the regeneration of southern pine by Michael J. Harvey. (10 minutes)
11. Variation in the central markings of the Mississippi Ringneck snake by Marion D. Hassell. (10 minutes)

BOTANY SECTION

Mary Wharton, Chairman

Edward Browne, Secretary

1. The Present Status of Work on the Kentucky Flora Project. E. T. Browne, Jr., U. K. (15 minutes)
2. Report on the Botany of Bourbon County, Kentucky. Edi Guhardja, U. K. (15 minutes)
3. The Importance of Voucher Specimens in Cytotaxonomic Studies. H. P. Riley, U. K. (15 minutes)
4. The Development of *Meloidogyne hapla* and *M. incognita* in Alfalfa. R. A. Chapman, U. K. 2 x 2 in. slides. (15 minutes)
5. The Effect of Moisture Level and Potassium Nitrate Level on Weight and Alkaloid Content of Two Genetic Lines of Burley Tobacco. Carl E. Henrickson and R. B. Griffith, U. K. 3¼ x 4¼ in. slides. (15 minutes)
6. A Possible Mechanism of Resistance to Wildfire in Tobacco. Phillip R. Fisher and Raymond E. Hampton, U. K. 2 x 2 in. sildes. (15 minutes)
7. Enzymatic Changes in Carrot Infected with *Thielaviopsis basicola*. Raymond E. Hampton, U. K. 2 x 2 in. slides. (15 minutes)

8. Some Observations on Plant Life in Indonesia. J. H. B. Garner, U. K. (15 minutes)
9. The Origin and Development of Rhododendron Heath in Eastern Kentucky. J. C. Warden, U. K. 2 x 2 in. slides. (15 minutes)
10. A Quick Method for Making Slides Permanent for Cytological Work. Debdas Mukerjee, U. K. 3¼ x 4¼ in. slides. (10 minutes)
11. A Preliminary Ecological Study of a Small Escarpment Mesa in Cumberland National Forest—Menifee County by David John and Amanda Russell, Asbury College.

CHEMISTRY SECTION

Arthur Fort, Chairman

Thomas Kargl, Secretary

1. "Dimethyl Sulfoxide Solutions of Sucrose". Paul G. Sears (15 minutes)
2. "The Kinetics of the Ultra-Violet Isomerization of Benzalacetone." N. F. Bray and T. H. Crawford. (20 minutes)
3. "The Kinetics of Radio-Induced polymerization of Methyl Methacrylate at Low Temperatures." E. C. Weber and N. T. Lipscomb (20 minutes)
4. "The Vertical Distribution of Total, Organic, and Acid-Soluble Phosphorus in Eight Kentucky Soil Profiles." C. E. Gentry and F. B. Gailey.

BREAK—5 to 10 minutes

5. "The Effect of Alkyl Groups on the Carcinogenicity of Heterocyclic Azo Dyes." E. V. Brown.
6. "Trace Element Determinations in Natural Materials by Activation Analysis." J. L. Setser, P. A. Baedecker, and W. D. Ehmann. (20 minutes)
7. "The Entropy of Monoclinic Sulfur." Donald Sands.
8. "The Determination of Formation Constants of Acetyl Acetonate from Solvent Extraction Data." Mary Richardson, H. C. Eckstrom and W. F. Wagner.

PSYCHOLOGY SECTION

Louise Miller, Chairman

1. A Development Study of Probability Learning by Betsy Estes and Mary Ellen Curtin, University of Kentucky.
2. The Locus Dimension in Electrocutaneous Communication by Emerson Foulke, University of Louisville.
3. A Study of MMPI Profiles of a Group of Wives of Alcoholics by Allie Hen? dricks and Billie Corder, Eastern State Hospital.
4. Discrimination Learning with and without Knowledge of Results by Louise B. Miller, University of Louisville.
5. Integrating Factors in Motivation Theory by Edward Newbury, University of Kentucky.
6. Equal Apparent Intensity Contours in Electrocutaneous Stimulation by R. Kent PeVault, University of Louisville.
7. The Differential Effects of Two Tranquilizing Drugs on Performance under Flickering Light by Paul L. Seyfirt, University of Louisville.

8. The Use of Ionizing Radiation as a Motivational Stimulus by Richard Smith, University of Louisville.
9. An Experimental Enquiry into the Role of Values in Behavioral Conformity by Connie Taylor, University of Kentucky.

GEOLOGY

James E. Conkin, Chairman

John C. Philley, Secretary

1. Arenaceous Foraminifera of the Northview Formation (Mississippian) of Missouri. James E. Conkin* and Barbara M. Conkin, University of Louisville. 35 mm. slides. (15 minutes)
2. Smaller Foraminifera of the Mississippian Hannibal Shale of Northeastern Missouri and Southwestern Illinois. James E. Conkin and James Pike*, University of Louisville. 35 mm. slides. (15 minutes)
3. The Role of Geology in Conservation in Kentucky. Preston McGrain, Kentucky Geological Survey. (15 minutes)
4. The Vertical Distribution of Mechanical Separates of Some Selected Kentucky Soils. Thomas E. Kemp, Berea College. (15 minutes)
5. Notes on a Study of Paleozoic Palaesis. James E. Conkin and David Bickel*.

PHYSICS

Richard Hanau, President

Otis K. Wolfe, Jr., Secretary

1. The Determination of Impedance Using Current Steps. M. Schwartz and W. Dennis, University of Louisville.
2. Spectra of Protons and Alpha–Particles Emitted from CsI (TI) under Fast-Neutron Bombardment. T. Young, F. Gabbard, B. D. Kern, and J. L. Beach, University of Kentucky.
3. The Coriolis Acceleration. J. M. Pike, Asbury College.
4. The Relation Between Inflow Angle and Size in Cyclonic Storms. J. G. Traylor and J. M. Pike, Asbury College.
5. Some Observations on Science in Europe. W. Noll, Eastern Kentucky State College.

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* (Asterisk) indicates speaker.

INDEX TO VOLUME 23

INSTRUCTIONS FOR CONTRIBUTORS

The TRANSACTIONS OF THE KENTUCKY ACADEMY OF SCIENCE is a medium of publication for original investigations in science. Also as the official organ of the Kentucky Academy of Science, news and announcements of interest to the membership are published therein. These include programs of meetings, titles, abstracts of papers presented at meetings, and condensations of reports by the Academy's officers and committees.

Papers may be submitted at any time to the editor. Each manuscript will be reviewed by one or more editors before it is accepted for publication, and an attempt will be made to publish papers in the order of their acceptance. Papers are accepted for publication with the understanding that they are not to be submitted for original publication elsewhere, and that any additional printing shall be at a later date and shall be designated in an appropriate credit line as a reprint from the TRANSACTIONS OF THE KENTUCKY ACADEMY OF SCIENCE.

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Titles must be clear and concise, and provide for precise cataloging. Textual material should be in clear, brief, condensed form. Footnotes should be avoided. Tables and illustrations are expensive and should be included only to give effective presentation of the data. Articles with an excessive number of tables or illustrations, or with poorly executed tables or illustrations, may be returned to the author for modification.

Line drawings and half-tones will appear as *text-figures.* Drafting should be carefully done (hand lettering generally is not satisfactory). Photographs should have good contrast and be printed on glossy paper. Text-figures are to be numbered consecutively and independently; on the back of each its number and the author's name should be written lightly in pencil. Each text-fiure must be referred to specifically in the text and must be provided also with a legend, the latter to be supplied as typed copy separate from the figures. Figures should be arranged into groups whenever possible and the legend for each group written as a separate paragraph. The amount of reduction desired should be indicated and should be consistent with the page dimensions of this journal. Indications of magnification should apply to the reduced figure.

The aim of the paper should be made clear in the introductory portion. If the paper is of more than a few pages it should contain a brief "Summary," which should be lucid without recourse to the rest of the article. In the interest of bibliographic uniformity, arrange all references under a "Literature Cited" heading, alphabetically by author and date, unnumbered, with textual citation by parenthetic insertion of author and date, as (Jones, 1940), or Jones (1940). Use initials for given names. Titles must be included. Abbreviate names of journals, using the form employed by Chemical Abstracts or Biological Abstracts. Separate the volume number from page numbers by a colon. References to books should include also the place of publication and the publisher.

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